Electrical Review

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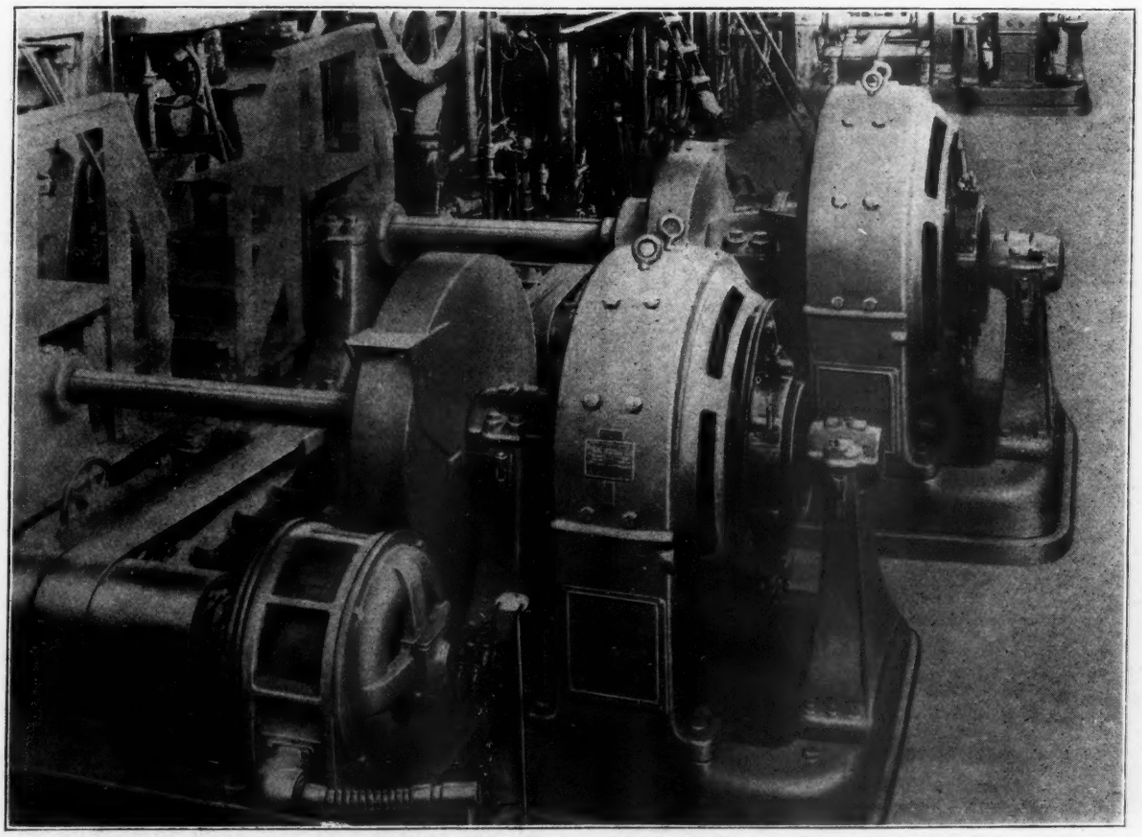
Electrical Equipment in Paper-Manufacturing Plant

Saws and Wood Pulp Grinders Driven by Motors—Sectionalized Motor Drive Used in Connection With Newest and Largest Paper Making Machine—Belt-Connected Motors Used in Older Mills

By W. A. SCOTT

The manufacture of news-print paper constitutes the principal industry at Oregon City and West Linn, Oregon, the two towns being situated at the falls of Willamette river and 15 mi. from Portland. The larger pulp and paper mills at this point are those of the Crown Willamette Paper Co. at West Linn. Its several mills and plants extend for a distance of half a mile along the ship canal that cuts around the falls on the west side. The buildings occupy ground between the canal and the river so that ready facilities for transportation by water are afforded.

The first three centers of operations, which are at the upper end of the group, consist of the saw mill and cut-up plant, the pulp-grinding section, and the sulphite treatment plant. The other principal buildings in the group consist of four paper mills which in the aggregate are equipped with nine paper machines. Mills *C* and *D* contain six steam-driven machines. Mill *J* has two motor-driven paper machines in which the several sections of each machine are connected to a line shaft by means of belts and cone pulleys. Mill *K*, the largest of the group, and built within



View Showing Two Motor Equipments Operating a Part of One Paper Machine.

the last year, contains a 9-section paper machine equipped for sectionalized motor drive.

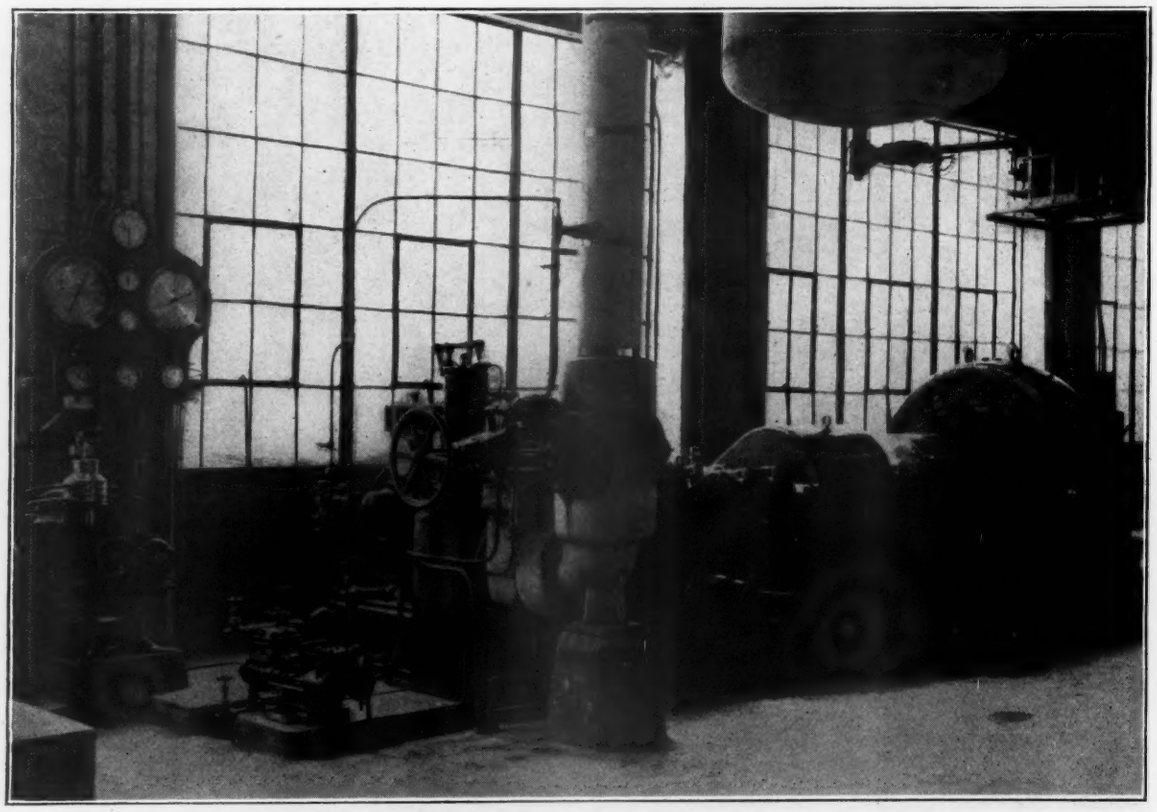
In this form of electric drive, which was produced by the General Electric Co., the driving unit for each section consists of a 100-hp., 136-r.p.m. direct-connected motor on the base of which is mounted a 20-hp. synchronous motor. The latter is connected to the main motor by a fabroil gear and a pair of cone pulleys connected together by an 8-in. 2-ply leather belt. The effect of the synchronous motors is to so synchronize the sections of the machine as to maintain between them an unvarying speed relation. The power for this paper machine is supplied by a 600-kw. d-c. generator which is driven by a De Daval 1000-hp., 3600-r.p.m. geared steam turbine. The generator, with a pressure of 150 volts, has a speed of 900 r.p.m. Eight of the paper machine sections are equipped for direct motor drive as above indicated, but the reel section is operated by a direct-connected 30-hp. motor. The speed of the entire machine is controlled by the generator voltage, and the machine sections are started and stopped by drum controllers.

When an increase or decrease of load occurs on any particular section, the synchronous motor absorbs the change in load and distributes it over the entire machine, thus preventing the load change from varying the speed of the motor connected to that section. This result is attained by connecting all the synchronous motors to a dead bus. This arrangement of sectionalized drive is adaptable to either high-speed or low-speed machines. This particular paper machine is designed for high-speed operation, producing paper 164 ins. wide at the rate of 1000 ft. per min. The first section receives the stock in liquid form and passes it on to five successive press sections through which the moisture in the moving web is gradually reduced. The press sections are followed by the dryer sections, each cylindrical dryer being heated from within by exhaust steam from the steam turbine. The paper, thus dried, pases next to the calendar stack by which it undergoes the finishing process. The reel makes up the last section which synchronizes with the rest of the machine in winding the paper into rolls.

Electric drive with a-c. motors is utilized in all four paper mills for the operation of beaters, jordans and pumps. In the case of the jordan machines all motors are direct-connected except for those in the older mills where belt transmission prevails. Each one requires a 250-hp., 400-r.p.m. motor. In the entire group of plants the handling of water, pulp and solutions requires about 60 direct-connected motor-driven centrifugal pumps of various capacities. Those used for pumping pulp are of special design, each pump being driven by a 250-hp. motor.

In the mills and plants mentioned there is a connected motor load of 11,000 hp., of which about 1060 hp. is on the 9 d-c. units that constitute the sectionalized drive for the new paper machine. Alternating-current motors are utilized for all drives except those of the new paper machine above described.

This company has a hydroelectric plant on the premises rated at 3600 kw., the water wheels for the four units operating under an average head of 34 ft. Additional energy is purchased from a central-station company. This is delivered at 57,000 volts to the paper company's 4000-kw.



View of De Laval Steam Turbine Driving Direct-Current Generator in Crown-Williamette Paper Mill.

transformers through which the voltage is stepped down to 600 for motor drives. The substation is situated 1500 ft. from the hydroelectric plant, and all substation apparatus is controlled from the generator room.

In the utilization of water power at this site the company operates as a lessee. In addition to the water required for its hydroelectric units about 7200 hp. is utilized for operating pulp grinders by direct-connected water wheels. In this installation there are four steel penstocks leading to four 42-in. double-runner wheels of 1800 hp. each. Each water wheel drives a pulp-grinding equipment of four grinders to each unit. The average head on the water wheels is 34 ft., as in the case of the hydroelectric units.

Ground pulp, produced from hemlock wood, forms the major constituent of newsprint paper. To this, however, is added a certain amount of chipped wood which is treated at the sulphite plant. The ground-wood pulp and sulphite-treated wood are mixed in the requisite proportions to make a stock pulp of the proper constituency for the jordans and paper machines.

The electrically operated saw mill and cut-up plant work up logs of a maximum length of 100 ft. and a maximum diameter of 7 ft. In reducing the logs to blocks of suitable sizes for the pulp grinders 13 motor-driven gangsaws are operated. The transfer of the blocks from the cut-up plant to grinders is accomplished by a system of motor-operated chain-belt conveyors.

ENGLISH OIL-BREAK SWITCHES FOR LOW-VOLTAGE CIRCUITS.

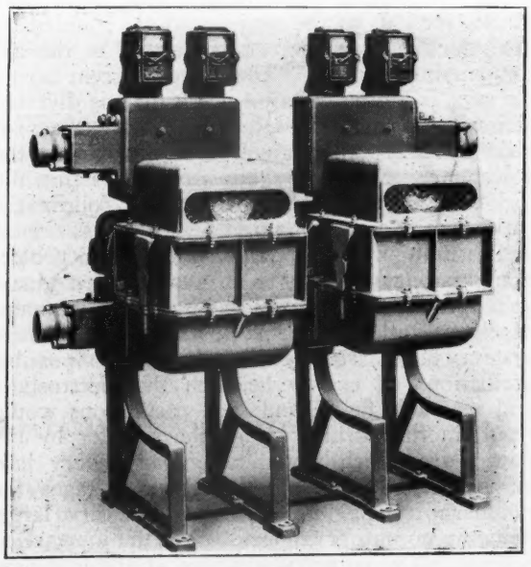
Live Parts Inclosed in Cast-Iron Cases With Suitable Provision for Inspection When Switches Are "Dead."

The type of ironclad oil switch shown in the accompanying illustrations, combined with an ammeter and mounted in a self-contained cast-iron supporting framework, is very common in England and represents general British practice. The oil tank is provided with a simple and handy lowering gear so that the switch contacts may be examined and adjusted if necessary. The top cover is hinged, and proper locking devices are provided so that no part can be got at unless the circuit has been disconnected. On the other hand, successive improvements in design have led to a type of switch of which every part is readily accessible when it is safe to handle. No part can become alive until all the covers are again closed. For voltages below 650 the interlocking devices may be omitted if so desired by the purchaser, but it is customary to provide them. The plugs which connect the supply to the oil switch cannot under any circumstances be withdrawn or inserted except when the switch is in the "off" position. One illustration shows the fully interlocked switch drawn out and opened for inspection. In the other illustration two units are shown mounted side by side, thus forming a 2-panel distributing board. Each panel comprises a loose-handle automatic oil switch with draw-out isolating features, ammeter and watt-hour meters suitable for unbalanced 3-phase load. Any number of units may be mounted side by side, and any desired combination of switches, starters, fuses, instruments, etc., can be built up to form a self-contained switchboard or control unit complying with British factory and mining regulations, which regulations have led to the development and extensive use of this type of

Switch With Case Opened for Inspection of Parts.

switch panel. The various panels are coupled together by means of a bus chamber (also entirely inclosed) running along the back, thus forming a complete distribution board. For mining work the switches are always of the oil-immersed type with wide machined flange joints between the various castings.

The views which illustrate these notes were supplied by the Electrical Apparatus Co., of London, England, manufacturers of this and other types of switchgear.



Two Switches Mounted Together With Meters in Place.

Lightning Arresters on Overhead Power Systems

Multigap, Electrolytic and Oxide Film Apparatus—Use of Condensers to Relieve Lines of High-Frequency Surges—European Practice—Economic Features of Protection Against Lightning

By ALFRED STILL

Previous articles have dealt with the means employed to maintain service and protect transmission lines from damage. The important question of protecting the line itself and the apparatus connected thereto from lightning and over-voltages was discussed in the article which appeared in ELECTRICAL REVIEW of May 7, 1921, but the only form of lightning arrester therein described was the horn-gap type. It is now proposed to describe briefly other forms of arrester in general use, together with the devices employed to prevent high-frequency surges or oscillations causing damage to machinery or line insulation.

MULTIPLE GAP ARRESTER WITH NON-ARCING CYLINDERS.

This type of arrester has several gaps in series, no single gap being greater than 1/16 in. These gaps occur between successive cylinders of "non-arcing" metal as used in the early types of arrester first designed by A. J. Wurts. This is essentially a device for use on a-c. circuits, the principle of its action being as follows:

The high-frequency discharge opens up the way for the power arc to follow, but this arc is extinguished when the current wave passes through the zero value and the peculiar nature of the "non-arcing" metal used in the cylinders prevents the arc re-forming on the reversed potential of the following half wave.

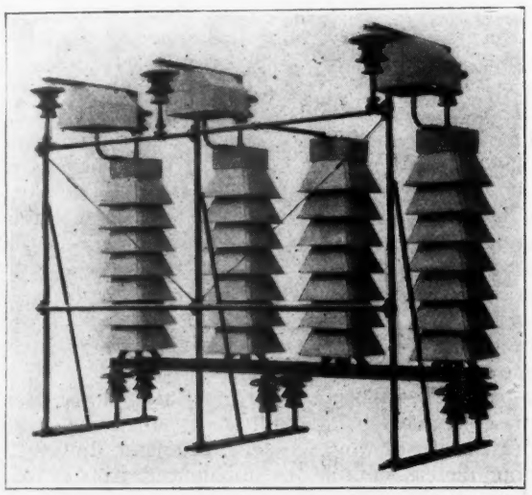
In order to avoid the destruction of the arcing cylinders by a heavy power arc, which might cause overheating even in the time of a half period, sections of the series gaps are shunted by noninductive resistances as indicated in the accompanying diagram. The power current across the gaps is limited because much of it is diverted through the resistances, and, moreover, the provision of these noninductive shunts makes the power arc across the gaps unstable. But the high-frequency lightning discharges follow the path across the gaps.

The multigap arrester gives very good protection on a-c. systems up to 20,000 and even 33,000 volts, provided the system has not a large amount of electrostatic capacity. But most high-voltage systems have large capacity, leading to possible oscillations of energy between the electrostatic and magnetic fields, and such oscillations would result in the burning up of the arrester by the power arc which would accompany every half wave. Even on moderately high voltages the number of gaps in series becomes very large, being by no means proportional to the increase of voltage. The potential gradient at the end near the line is higher than at the end near the ground connection. Recent improvements tend to equalize the potential gradient, either by providing a ground shield to reduce the difference of potential between cylinders and surrounding objects at the line end of the arrester or by making a few of the cylinders near the line connection of larger diameter than the remainder. This improvement has recently been made on some arresters of this type on European power systems. It is illustrated in the diagram previously referred to. If the electrostatic capacity between the consecutive elements of the arrester can be made large relative to the capacity to ground a more uniform drop of potential over the series of elements will result, thus rendering this type of arrester more suitable for the higher pressures. The introduction of condensers to increase the capacity from element to element is the basis of the Moligniani system which has been patented and is in use in Italy. It seems probable, however, that the high cost of the condensers will stand in the way of this method proving superior to other possible alternatives.

A special form of multigap arrester is the compression-chamber arrester in which the pressure of the gases caused by the heat of the discharge is helpful in extinguishing the power arc.

LIGHTNING ARRESTER WITH AUXILIARY FUSES OR CIRCUIT-BREAKERS.

The power current following a discharge may be interrupted on medium voltage and on small power systems by connecting some self-acting device, such as a fuse or automatic circuit-breaker, in the ground connection; and arresters,



Oxide Film Lightning Arrester for Outdoor Service on 3-Phase, 50,000-73,000-Volt Circuit.

whether of the horn type or with any other kind of spark gap, are sometimes provided with fuses so arranged that when one fuse blows the dropping of a lever or an equivalent device automatically inserts another fuse so that the system is not left unprotected. In the Garton-Daniels type of arrester, for use on a-c. circuits up to 20,000 volts, the principle of the multiple gap is combined with a simple type of automatic circuit-breaker connected as a shunt to some of the spark gaps in order that the discharge path for the lightning shall remain unaltered even during the operation of the arrester.

The action of this arrester is illustrated by an accompanying diagram. The discharge follows the straight path through the two sets of air gaps and the resistance rod. The power current following the discharge will, after passing through the two upper gaps and the resistance rod, be shunted by the low resistance winding of the circuit-breaker; and if this following current is too heavy to be ruptured by the combined action of these two gaps and the resistance rod the iron armature of the circuit-breaker will be lifted by the action of the solenoid, thus throwing the two lower spark gaps in series and extinguishing the arc.

Principle of the Aluminum Cell Lightning Arrester.

When two aluminum electrodes are immersed in a suitable electrolyte an insulating film of hydroxide of aluminum is formed on the surface of the metal; this effectually prevents the passage of any appreciable amount of current until a certain critical voltage is reached, when the film breaks down and the current is limited only by the resistance of the electrolyte. On lowering the voltage the film is re-formed and the flow of current is again limited to a very small amount.

With alternating current the critical potential difference per pair of plates is about 300 volts, and the practical construction of lightning arresters on this principle consists in stacking a large number of cone-shaped aluminum plates, one within the other, with suitable separating washers of insulating material between them. In this manner a column is formed of a large number of cells in series, capable of withstanding high voltages. The whole is inclosed in a case containing oil which improves the insulation and prevents the evaporation of the electrolyte which fills the spaces between adjacent trays within a short distance of the edge.

If cells built up in this manner are connected directly between the line and the ground there will be an appreciable current passing through them, which is partly a leakage current, but chiefly a capacity current. It is therefore customary to insert a spark gap—usually of the horn type—in series with the aluminum cell arrester, the gap being set to break down with a pressure slightly in excess of the normal working voltage.

Although the film of hydroxide is formed on the plates at the factory before the arresters are installed, it is necessary to maintain it by periodic "charging" of the cells, this being done by closing or nearly closing the spark gap in series so as to put the full line pressure across the arrester. It is generally recommended that this be done once every day.

The effect of "charging" the cells by passing an alternating current through the arrester is to coat the electrodes with a thin insulating film of hydroxide of aluminum, the thickness of which is sufficient to withstand the line voltage. When this film is punctured by an over-voltage the current passing through the many minute punctures re-forms the insulating film and thus prevents the passage of any but capacity and leakage currents until the applied pressure again exceeds the critical voltage. The principle of this type of arrester is therefore well adapted for the protection of large high-voltage a-c. systems, and in practice it has given excellent service. Its chief disadvantages are its cost, the attention it requires in the matter of daily charging, the impossibility of testing its condition while in use, and the necessary spark gap which may be the cause of destructive oscillations in the system.

In this connection it is true that on high-pressure systems the surges set up by spark gaps

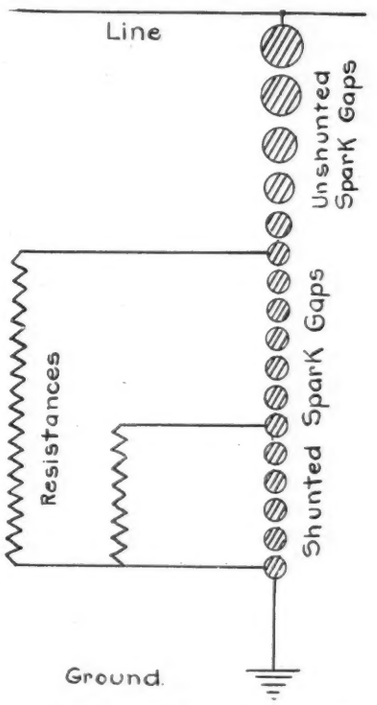


Diagram of Multigap Lighning Arrester With Shunting Resistance.

in series with the cells are unlikely to cause serious trouble, but this suggests the possibility of simpler and less costly devices such as scientifically combined graded horn gaps as used with success in Europe. If the aluminum cell arrester could be so modified that it could be permanently connected between line and ground without a spark gap in series, and if the necessity for daily "charging" could be dispensed with, this type of protective device would be ideal for use on all high-voltage a-c. systems.

Features of the Oxide Film Lightning Arrester.

What is known as the oxide film arrester has two particular operating advantages in that it has no liquid electrolyte and it does not require daily "charging." The electrodes of this arrester are circular discs of sherardized iron held apart

by a porcelain ring, the active material between the plates being lead peroxide. This material is a fairly good conductor of electricity, but the effect of an electric discharge is to convert it into a lower oxide which is an insulator. Under the action of the line voltage the growth of this non-conducting film at the surface of the electrodes continues until it is thick enough to check the flow of current, the electro-motive force across each pair of electrodes being from 250 to 300 volts. The number of cells in series is chosen so that only a very small leakage current passes through the arrester when subjected to normal line pressure. Nevertheless it is found necessary to provide a spark gap in series, which is one of the disadvantages which it shares with almost every other type of lightning arrester. When an over-voltage occurs, i. e., when the spark gap discharges, the insulating film of oxide is punctured and the discharge occurs through the lead peroxide, but the puncture holes are sealed up by the passage of the current. The oxide film arrester can be used on high-voltage a-c. circuits in places where there are no attendants and where other types of equipment could therefore not be used.

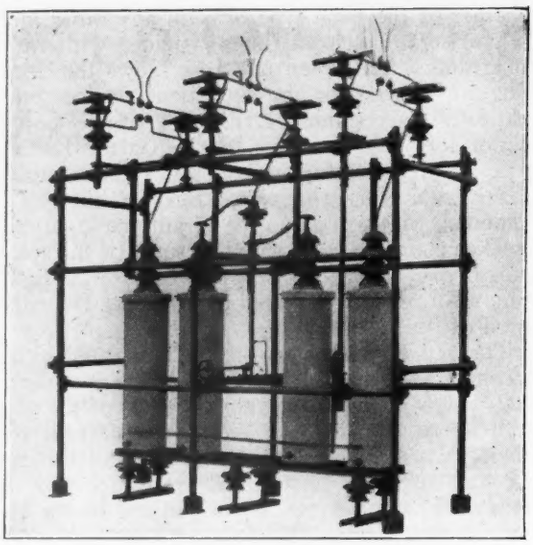
European Practice—Water-Jet Arresters.

In order to relieve the line of high potential "static" the water jet is frequently used in Europe. By directing a stream of water from the nozzle of a grounded metal pipe on to the high-tension conductors a high-resistance noninductive path to ground is provided for the extra-high potential charges on the line. It is claimed that arresters constructed on this principle have been found useful in practice, but the employment of jets of water has its objections. If the jets are left continuously in action there must necessarily be an appreciable leakage of power current, and if only turned on when electric storms are pending there would appear to be too much reliance placed on the "human element" to afford proper protection. It is claimed that if the size and length of the jet are so adjusted as to pass a current of between 0.1 and 0.2 amperes on normal voltage the line will be protected against dangerous pressure rises.

Condensers as Protection Against High-Frequency Surges.

No apparatus including a spark gap set to discharge at pressures above the normal line voltage can adequately protect all apparatus against the effects of high-frequency discharges. High-frequency disturbances of which the maximum voltage is less than the line voltage may do damage to transformers and other apparatus by causing very great differences of potential between adjacent turns of the windings, or between two conductors in the same slot of a generator or motor armature.

A condenser acts as an almost perfect insulator so far as direct currents are concerned; but it is pervious to high-frequency currents, and a suitably designed condenser, or rather battery of condensers, connected between line and ground without the intervention of any spark gap, is certainly an ideal device for dealing with the high-frequency oscillations that accompany lightning phenomena. This is the chief function of the Mosciki condensers which, although not largely used on this continent, have found favor in



Aluminum Cell Lighting Arrester for Outdoor Service on 3-Phase, 25,000-37,000-Volt Service.

Europe—where they have been in use for many years in almost every country—and also in South Africa and China.

The traveling waves induced by a lightning discharge on a transmission line may have a frequency of the order of 1000 to 5000 cycles per sec., and a set of condensers which will pass but a very small current at 25 to 60 cycles will deal with much larger currents on these higher frequencies. As a matter of fact, an electric discharge between a cloud and the ground, or between cloud and cloud, may induce in the line traveling waves having frequencies considerably in excess of 100,000 cycles per sec. This is proved by the fact that wireless telegraphic apparatus which responds only to frequencies ranging between about 100,000 and 1,000,000 cycles per sec. is interfered with by atmospheric electric storms. A 40-ampere fuse in series with a condenser has been blown during an electrical storm, although the condenser could not possibly pass more than 1% of this current on frequencies of 3000 or 4000 cycles.

When high-frequency disturbances occur in a system of conductors the traveling waves are short and the point of zero potential may be only a few hundred feet behind the point of maximum potential. If, therefore, a traveling wave of this nature enters a piece of electrical machining such as a generator or transformer the full difference of potential, which may amount to only a few thousand volts, may be applied across adjacent layers of the coil winding, thus causing a puncture and ultimate breakdown of the insulation, even if the apparatus as a whole is insulated to withstand pressures of 100,000 to 200,000 volts to ground. As a protection against trouble of this sort from high-frequency induced charges the condenser appears to offer a good solution.

It must not be understood from these comments on the uses of condensers as lightning arresters that the discharge is diverted to ground through the condenser and so dissipated, much as energy would be dissipated in a resistance, because the condenser cannot absorb or dissipate any but the smallest percentage of the energy passing through it. The energy is necessarily redelivered to the

line from which it originally came, and is ultimately dissipated through the ohmic resistance of the conductors. The function of the condenser is, in fact, somewhat analogous to that of an air chamber on a water pipe in which the rate of flow is subject to sudden variations.

In view of the fact that the condenser merely shunts the high-frequency oscillations and so prevents damage to the apparatus to be protected, but returns nearly all this energy to the line where it ultimately dies out owing to the conductor resistance, it would seem advisable to provide some small amount of resistance in series with the condensers even at the risk of slightly higher surge pressures across the apparatus to be protected. The intelligent combination of condensers, reactance coils, and resistances may be expected to afford good protection, but there is always a danger of resonance effects at certain critical wave frequencies.

Construction Features of the Mosciki Condenser.

These condensers, which are extensively used in Europe for line protection, consist of thin glass tubes coated inside and out with a thin chemically deposited conducting layer of silver which is thickened by being electroplated with copper. These glass tubes are about 0.5 mm. thick, but increase in thickness at the neck where the metal coatings end. This prevents the formation of corona and possible breakdown at the edges of the metal coatings. Each tube can withstand over 60,000 volts without puncture. In the early types of these condensers metal foil was used on the glass, but it was found impossible to exclude air spaces, and these ultimately became enlarged and led to trouble. The silver deposit appears to be entirely satisfactory. The edges of the coatings are completely covered by an insulating compound to prevent brush discharge. Each unit tube is surrounded by a brass tube, the space between the tube and the outside coating of the condenser being filled with a mixture of water and glycerine which conducts the heat from the condenser coating to the metal tube and prevents local overheating. The working pressure per tube is usually not in excess of 15,000 volts, and the units are grouped in series and parallel to provide batteries of the requisite capacity.

It is true that maintenance of service is of very great importance, but the engineer must, nevertheless, consider carefully the economic considerations involved when proposing to increase the automatic protection on a system over and above what may be necessary to give reasonably good protection. Lightning arresters may be provided in abundance on an overhead system, and assuming—what does not necessarily follow—that such profusion of protective apparatus will lessen the number of accidents due to lightning and similar causes, it does not follow that they should be installed. The cost of such additional apparatus must be set against the estimated cost of more frequent shutdowns, and the advantages of simplicity with the smallest possible number of parts or machines requiring attention must never be overlooked.

Suppose, for instance, that by protecting only the large transformers the annual damage to the transformers on the whole system does not amount to more than 1% of the total number in service (a not unusual percentage). It is certainly questionable and probably doubtful whether there is any justification in protecting all transformers, including those of very small capacity, by lightning arresters under such circumstances. Present-day practice favors lightning protection for all transformers of 20-kw. capacity and larger, although it is admitted that a more extensive use of lightning arresters might reduce the losses from, say, 1% to 0.5% per annum.

One point that is sometimes overlooked is the effect of the line current on pressure disturbances. The disturbances that are set up by switching operations or by power arcs following a lightning discharge will be far more serious when the current is large than when it is small. This is one reason why extra-high-tension transmissions suffer less from lightning disturbances than moderate-voltage systems on which the current is often larger. It is hardly an exaggeration to say that the handling of heavy currents on long-distance transmissions presents more engineering difficulties than insulation problems on the high-voltage schemes.

Very-high-voltage transmission lines may, indeed, operate satisfactorily without lightning protection, especially when working at pressures near the critical voltage of the corona formation, and

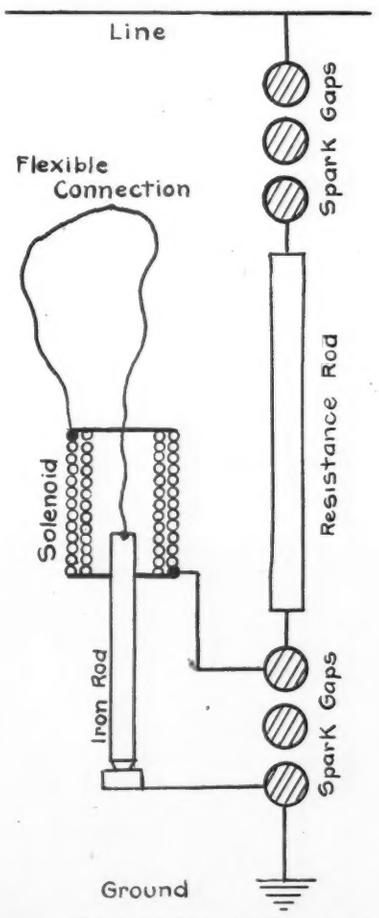


Diagram of Garton-Daniels Lighting Arrester.

some relief to high-pressure energy is afforded by the corona itself. Low-pressure lines, working at about 10,000 volts, are usually far less exposed than the high-pressure lines, and the low-pressure

lightning arresters are rather more effective than those for the higher pressures. Such lines do not give so much trouble as those working at pressures between 30,000 and 80,000 volts.

Corona as a Protection Against Over-Voltages.

The luminous discharge from the surface of an overhead conductor, to which the name "corona" has been given, occurs when the pressure exceeds a certain critical value depending upon the diameter and spacing of the wires. It is accompanied by a certain loss of energy which depends upon the frequency and the voltage. This loss may be considerable on a long line if the voltage is much in excess of the critical value at which corona forms. It is proportional to the *square* of the *excess* of pressure over the disruptive critical voltage, and a small increase of pressure will therefore lead to an enormously increased dissipation of energy in the air.

This property of the corona suggests the possibility of working high-voltage transmission lines at a normal pressure in the neighborhood of the critical disruptive voltage where the loss would be inappreciable. An extra-high-voltage discharge, due either to atmospheric lightning or to internal causes, would then be largely dissipated in the corona itself. This may to some extent account for the fact that fewer lightning troubles are experienced on the very-high-voltage transmissions than on the lower voltage lines. The insulation of the conductors being such as to withstand, without breakdown, pressures considerably in excess of the disruptive critical voltage of the corona, a large amount of oscillating energy can be dissipated in the air before the voltage rises to such a value as to pierce or shatter insulators or damage apparatus connected to the line. On the other hand, too much reliance should not be placed on the corona as a means of dissipating large amounts of suddenly impressed energy; because lightning and similar disturbances, being to a great extent local, must discharge their power locally, and the corona losses over a short section of the transmission line cannot under any circumstances be very great.

Experiments made with barbed wire indicate that the provision of pointed elements of wire very greatly increase the amount of power dissipated by corona on over-voltages. It has lately been suggested by R. Nagel that stretches of an overhead line, each about 0.5 mi. long, might be specially barbed at points where protection is needed.

It is probable that future lines working at pressures in the neighborhood of 220,000 volts will suffer less from lightning disturbances than the lower voltage systems.

NOTE—This concludes the series of articles prepared by Prof. Alfred Still, dealing with the various problems involved in the present electric power situation. Previous articles appeared in Electrical Review of July 17, Aug. 7, Aug. 21, Sept. 4, Sept. 18, Oct. 2, Oct. 16, Nov. 13, Nov. 20, Dec. 4, and Dec. 18, 1920, and Jan. 8, Jan. 22, Feb. 5, March 5, April 2 and May 7, 1921.

The State Electricity Commission of Victoria, Australia, is interested in the various applications of electricity to domestic uses and, it is understood, is desirous of getting in touch with American agents who cater for such appliances as electrically operated refrigerators and gas heaters.

PETITION DISMISSED FOR WANT OF CAUSE OF ACTION.

The United States Court for the Eastern District of Arkansas at Little Rock, Ark., July 13 entered an order dismissing the petition filed the evening before by Morgan & Co. of Delaware against the Citizens Ice & Public Utilities Co. of Junction City, Ark., and the Arkansas Light & Power Co. of Pine Bluff, Ark. The petition requested a receivership for the two companies on the allegation that three bonds issued by the Citizens company and interest on $38,000 bonds of the Citizens company had not been paid. The Bank of Fordyce, trustee under the mortgage of the Citizens company, issued a statement as soon as advised of the institution of the suit that there was no basis for the Morgan petition, as the bonds and interest due, amounting only to $4141, had been taken care of, and declaring its name had been used as co-plaintiff without authority, and that it would not be a party to such an action. Officials of the Arkansas Light & Power Co. assert the filing of the petition seemingly was merely an attempt to injure the company.

The Arkansas Light & Power Co. supplies the Citizens Ice & Utilities Co. with gas and supervises its operation. Morgan & Co., although incorporated in Delaware, is controlled by S. R. Morgan of Little Rock, Ark., who owns an electric plant at Cargile, Ark., and which it is understood he recently sought to sell to the Arkansas Light & Power Co.

RADIO EXPOSITION PLANNED FOR CHICAGO.

A radio exposition is to be held at the Broadway Armory, 5875 Broadway, Chicago, Aug. 31-Sept. 3, under the auspices of the American Radio Relay League. It is understood that 50 radio and electrical concerns of the country will exhibit. Army and navy wireless work with airplane, artillery and torpedoes will be shown, according to announcement.

ATMOSPHERIC NITROGEN PLANT FOR SEATTLE, WASH.

The American Nitrogen Products Co., which operates a plant near Tacoma, Wash., and another in British Columbia for gathering atmospheric nitrogen has told the Port Commission of Seattle, Wash., that it will accept a 4-acre tract on Salmon bay, Seattle, as a site for an electrochemical plant if sufficiently cheap electric power in adequate quantities can be assured. The plant contemplated would cost $500,000.

ILLUMINATION FOR INDOOR SPORTS A CORRECTION.

Attention has been called to an error in the second paragraph on page 41 of Electrical Review of July 9, 1921. J. H. Kurlander, author of the article entitled "Illumination Requirements for Indoor Sports," has called attention to the fact that only 2 to 3 watts per sq. ft. is required instead of 20 to 30 watts per sq. ft. in the case under consideration.

Entering Bushings Designed for High Frequency

Radio-Telegraph Service Requires Bushings and Insulators to Withstand Strains Different From Those Imposed in Ordinary Power Transmission—Impact Test on Insulator for Radio Service

By GEORGE LEWIS

Chief Engineer, Electrose Manufacturing Co., Brooklyn, N. Y.

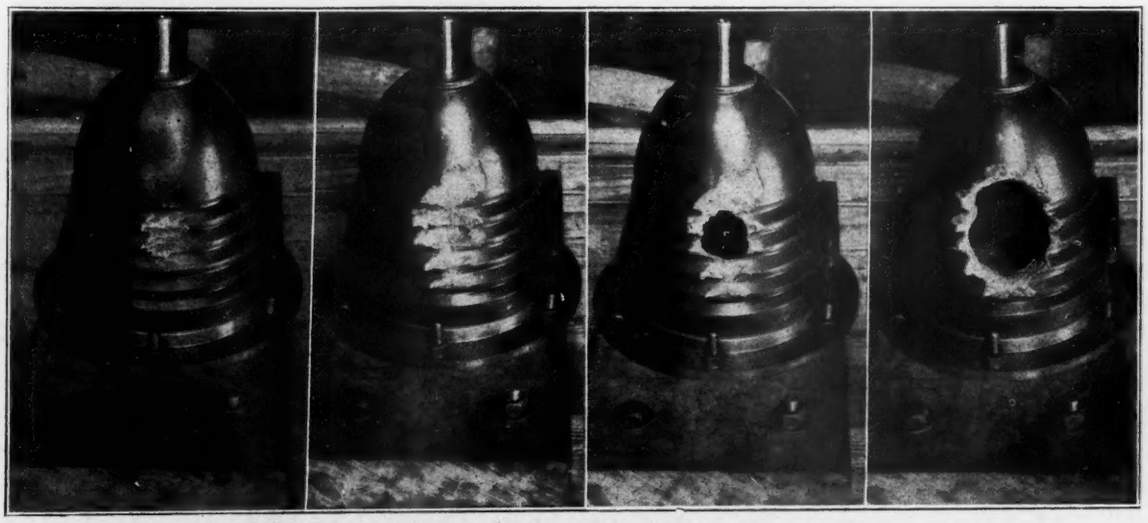
The advent of radio telegraphy was accompanied by many new problems in the design of insulators of the suspension and wall bushing types. These problems were brought about by an increase in frequency of several thousand times over the commercial frequencies utilized for power transmission. An attempt was made to utilize the designs of commercial insulators which existed at that time for these new high-frequency currents, but in stations where a power of several kilowatts was employed with the insulator working at any potentials greater than 20,000 volts the dielectric losses were sufficient to completely destroy the insulation. The first alteration in design of commercial type bushings was made in an endeavor to fit the insulator for use in connection with radio telegraph transmission by increasing the volume of insulating material between the points of opposite potential. At this stage of insulator design the general theory of proportioning insulating material was based on the assumption that an increasing potential must be accompanied by proportional increase in the volume of material.

During the early stages of radio telegraphy commercial bushing-type insulators which were altered by increasing the volume of material between the central conducting rod and the grounded flange frequently heated sufficiently to completely destroy the material. Insulators were then provided with internal metal shields in an endeavor to more uniformly distribute the electric field, and with the spark-type radio transmitters which were utilized up to within a few years insulators of this class rendered fairly satisfactory service as the alternating potentials herein employed were not continuously applied to the insulator at the maximum value, the successive applications of potential being reduced or damped in amplitude until the last few alternations were a very small fraction of the maximum potential as registered by a sphere gap.

Continuous-Wave Transmission Imposes Strains on Insulators.

This damped system, however, has recently been replaced by the continuous-wave type transmitter which supplies a pure sine wave potential of equal amplitude to the insulator, and insulators which had rendered fairly satisfactory service for the damped system were found to be practically useless for this new system. A new type of entering bushing which marks a departure in insulator design from the potential-proportional-to-volume theory has now been developed. This insulator is so designed as to maintain the dense portions of the electric field in air, thereby reducing to a minimum the dielectric losses and accompanying heating which so greatly determine the life of any insulator.

In the design of this insulator the following factors have been considered as contributing to the efficiency of an entering bushing which is subjected to high-frequency sustained voltages: (A) The dense field between the central conductor tube and the grounded securing flange is estab-



Views Showing Effect of 1, 7, 8 and 15 Impact Blows of 410 Ft.-Lbs. on High-Frequency Electrose Bushing.

Electrose Air-Gap Type of Bushing Tilted to Show Arcover Feature.

lished in air. (B) Supporting shell of Electrose insulation has a minimum volume, thereby attaining minimum dielectric loss with a maximum thermal radiation value. (C) The supporting shell of Electrose insulation is so arranged as to follow the curved lines of force. (D) Metal shields are so arranged as to properly control the external flux. (E) Flashover is established between the conductor tube and grounded flange at the potential rating of the insulator. (F) External flashover occurs from the metal shield to ground at a value greater than the potential rating of the insulator during the standard rain test. (G) The supporting shell of Electrose is of such formation as to resist gun shots or impact forces to the highest degree. The accompanying illustrations show the general shape and disposition of the metal parts in the insulator designed to meet these requirements.

A series of radio-frequency sustained wave tests have been conducted on an insulator of the above type where the test potential was obtained from a condenser of the air-dielectric type charged by a Poulsen arc transmitter having a maximum capacity in the neighborhood of 40 kw. The voltage obtained with this arrangement was limited to approximately 50,000 volts (maximum) by the insulation of the high-frequency condenser.

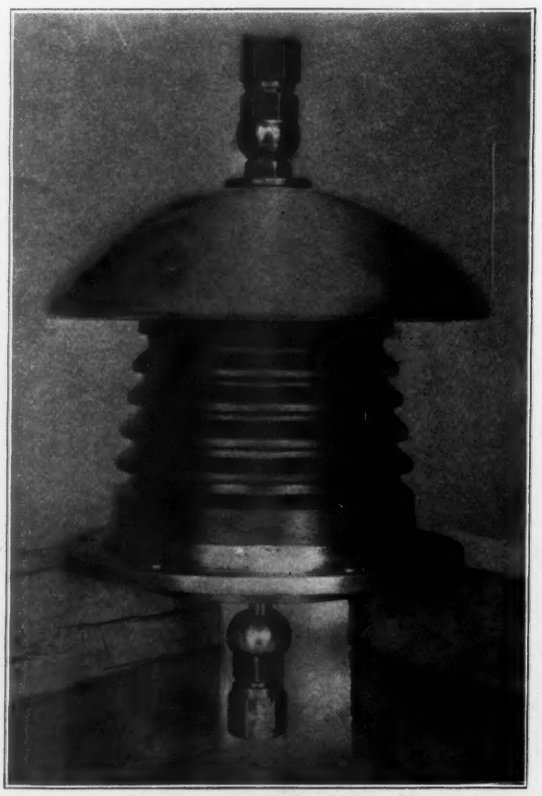
The results observed when impressing 53,000 volts (maximum) at a frequency of 85,000 cycles between the central conducting tube and the grounded flange indicated that this insulator fulfilled the requirements listed above, as no heating or surface corona could be detected after a run of 1 hr. It should be appreciated that tests of this character represent the most severe punishment that an insulator can be subjected to, as the rapidly alternating static field is sustained in the equipment here employed and not impact applications of steep front as is usually referred to in insulator testing. The electrical flashover characteristics of insulators of this type were obtained with a step-up transformer system delivering various potentials at a frequency of 60 cycles. The secondary potential of this equipment was practically a sine wave and increased at a uniform rate of 1000 volts per sec.

An average of 110,000 volts (maximum) was obtained for the outside dry flashover between the securing bolt heads of the grounded mounting flange and the lower portion of the flux shield. In order to determine this dry flashover it was necessary to remove the central conductor rod. This value of potential bears no relation to the functioning of the insulator other than proving the surface leakage distances as in service.

The insulator was arranged so as to be subjected to a mist falling at the rate of 1 in. in 5 min. as delivered from a system of spray nozzles impressing the spray over the surface of the insulator at an angle of 45 deg. to the horizontal. An average flashover value of 65,000 volts (maximum) was obtained under this spray test. The outside flashover can be varied from 50,000 to 100,000 volts by alterations in the height of the shield without materially lowering its duty as a flux control member.

Path of Flashover Influenced by Shape of Shield.

It may be well to note that the shape of the flux shield greatly controls the path of the flashover from this shield to ground. With the particular arrangement of shield here shown the flashover is first established to ground directly under the shield, and after a fraction of a second is bowed outward from the insulator shell. With other forms of shields the flashover was established directly on the insulator body at about a midway

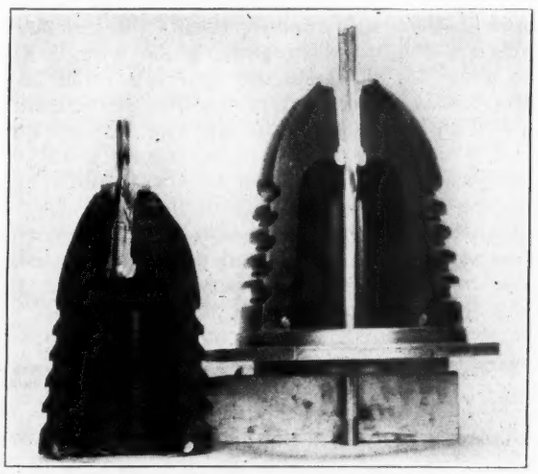


Air-Gap Type of Bushing With Static Shield and Connectors in Place.

point between the shield and flange, and after a very short interval the arc path gradually moved outward and was established directly in air between the shield and flange.

The design of this insulator so as to establish the zone having the maximum density of electrostatic flux between the conductor tube and the flange results in a three-fold function. The maximum density is established in air, thereby having a minimum electrostatic coupling and resultant dielectric loss between the members being insulated. The open-to-air arrangement lends itself to free air circulation, thereby preventing cumulative heating. Arcover is established on the dry end of the bushing, thereby permitting this arcover feature to be utilized in commercial power transmission gear as a protective device where the arcover value is only influenced by barometric pressure.

The insulator in its commercial form is fitted with a conductor tube having an outside diameter of 1.75 ins., and with a tube of this diameter the electrical distance to the flange is 2.5 ins. With this arrangement a potential of 75,000 volts



Bushing Cut Apart to Show Arrangement and Shape of Parts.

(maximum) is required to arcover to the flange at a temperature of 25 deg. C. and a barometric pressure of 76 cm.

From a number of observations which have been conducted on short co-axial cylinders after the general proportions shown in the bushing being described, where the axial length of the grounded flange is approximately 75% less than the air arcing distance to the central conductor, it has been found that the ratio of the radius of the inside of the flange to the outside of the central conductor varies between 3.45 and 3.70 and that this variation is directly proportional to the electrostatic coupling between the two members.

Various commercial designs of insulators of this general type are now being worked out for use in connection with small radio apparatus where it is desired to have as small a phase angle as possible as well as for use in connection with the larger high-power radio stations. From the data so far collected during the investigations of insulators of this type designs are being carried out for insulators which are applicable for transmission lines, oil-switch construction, transformer bushings and other installations of the high-voltage type where the insulator is at times subjected to high-frequency surges.

Impact Test to Determine Mechanical Strength of Bushing.

A series of impact investigations have been carried out on a bushing developed for use in the U. S. naval service for radio telegraphic purposes, an accompanying illustration showing one unit completely equipped for installation with connecting members and electrostatic shield. In these investigations a sphere was employed as the impact member. The sphere was selected in preference to other forms of hammers as it would automatically, when released, strike a square blow on the material being tested without the introduction of guides or other steering members. The impact was delivered to the insulator by a pendulum arranged with a 43-lb. sphere approximately 8 ins. diam. suspended in a direct line with the center of the insulator from a roller bearing secured to the ceiling of a room 12 ft. high. An adjustable feature was introduced in series with the chain to permit the impact weight to be raised or lowered to establish as nearly as possible a central impact.

Impact was delivered at a centrally located point on the flat ribbed portion of the insulator by releasing the sphere from a height of 9 ft. 6 ins., the force of each blow being approximately 410 ft-lbs. An accompanying illustration shows how the insulator stood the shock of repeated blows from the sphere. The insulator was not broken through until eight blows had been delivered, and 17 blows were required to break the top portion of the insulator away from the lower portion connected to the base. The wall of the insulator tested was approximately 1 in. thick.

WITHDRAWING ADVERTISING BUT NOT SALESMEN.

The head of a large organization declared the other day that he had decided to stop advertising because the amount of business derived directly from it was not satisfactory. He received this reply: "Are the orders coming in from your salesmen satisfactory at present?" He admitted that they emphatically were not. "Are you going to lay off all your salesmen?" he was asked. "Certainly not," he replied indignantly. "We've got to have our men out to keep in touch with the trade." Yet he had decided to stop the very thing which keeps his company and its product in touch with the trade and the public in a far more comprehensive way than his salesmen can possibly do. It is just possible that he will now change his mind.

The time to stop advertising is not when orders become extremely difficult to land and when plants sorely need business to keep them going. If an ambitious advertising program can increase the percentage of production even moderately, it thereby reduces the overhead per unit of production. Moreover, it reduces the number of employes that have to be laid off, and this ought to be a consideration of the first moment in times like these.

Don't sit back. Sit up. Don't give up. Get up.—*Forbes' Magazine.*

Transmission Characteristics of Iron and Steel Wire

Substitution for Copper in Places Where Strength of Span Is More Important than Conductivity — Atmosphere Free From Smoke and Other Impurities Proves Best for Iron or Steel Wire

By EDWIN KURTZ

Electrical engineers have frequently considered the use of iron and steel as a substitute for copper for transmission purposes, and the substitution has been made in a number of cases. The electrical characteristics of iron and steel wire, however, are not well known, nor have very complete data been available. The tables usually given for the resistance of iron and steel wire are of little value because of skin-effect when alternating current is transmitted over the wire. The magnetic flux set up in the wire has a tendency to crowd the current to the outside and thus only a portion of the wire is fully available for utilization. The effect of this unequal distribution of the current is to increase the power lost in the wire. The increased power loss is accompanied by increased voltage drop in phase with the current, and there is also some hysteresis loss in the wire.

For a-c. circuits the effective resistance should be used for computing the RI drop or the power lost in the wire. The effective resistance is found by sending alternating current of the proper frequency through the wire and dividing the power lost by the square of the current. The effective resistance depends upon the permeability of the iron, and therefore varies with the current and with the grade of iron used. These factors are so variable that values based on theoretical formulae are not reliable.

The values given in the accompanying curves are entirely the result of experiment and have been checked substantially from several sources. Figs. 1, 3, 5 and 7 show the effective resistance per mile for 60-cycle service for the grades of wire and cable most commonly used.

The reactance at 60 cycles in ohms per mile of conductor for copper or other nonmagnetic materials is given by the formula

$$X = 0.0303 + 0.279 \log \frac{S}{r}$$

where S is the spacing between wires and r is the radius of the conductor. Both S and r must be expressed in the same units. The second term of the expression represents the reactance caused by the flux surrounding the wire and is the same for all conductor materials. The first term in the expression represents the reactance caused by the flux within the wire. If an iron wire is used this term will be from 100 to 500 times as great as indicated by the formula, depending on the permeability of the iron. In the case of iron-wire transmission lines the second term is relatively small, and considerable variations made in the spacing between the wires affects the total reactance but slightly. In fact, if the reactance of a wire is computed for a spacing of 30 ins. between wires it can be used for spacings of 15 or 60 ins. with an error not exceeding 2.5% under the worst conditions, and usually the error will not exceed 1%. For spacings between 15 and 60 ins. the error will be correspondingly less. These errors may seem large at first, but it must be remembered that the resistance may vary several per cent depending on the temperature, that the resistance and reactance of samples of the same size and grade of wire may vary several per cent, and that both the resistance and reactance may vary by as much as 200% depending on the current. The reac-

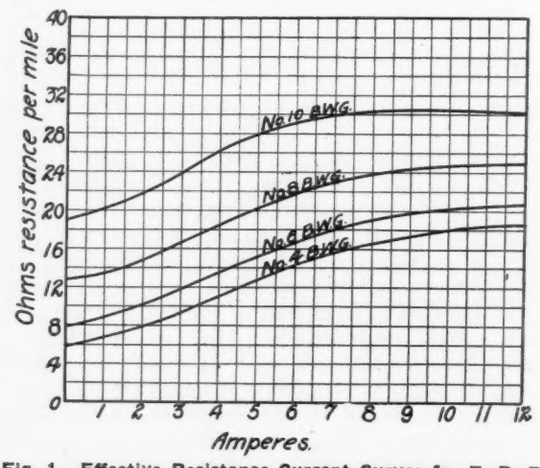


Fig. 1.—Effective Resistance-Current Curves for E. B. B. Wire at 60 Cycles.

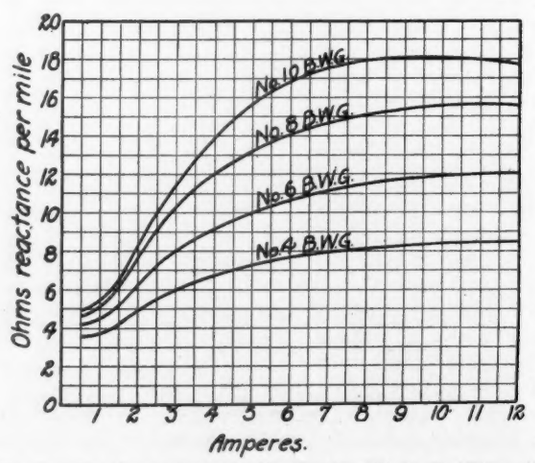


Fig. 2.—Reactance-Current Curves for E. B. B. Wire at 60 Cycles, with 30-in. Spacing.

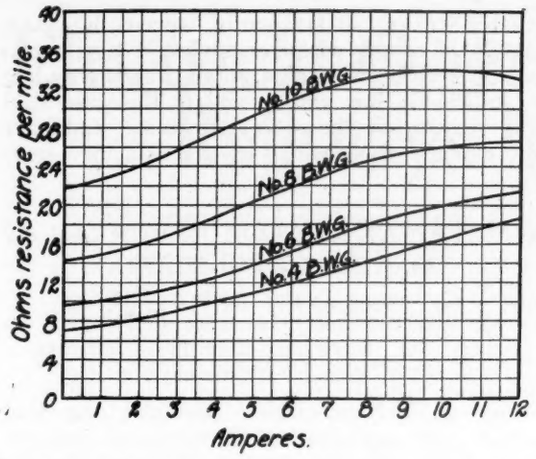


Fig. 3.—Effective Resistance-Current Curves for B. B. Wire at 60 Cycles.

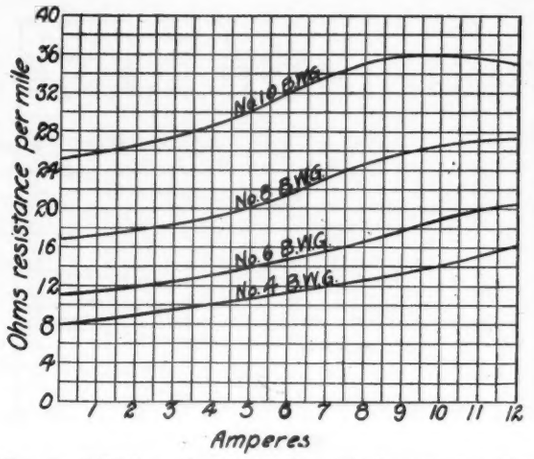


Fig. 5.—Effective Resistance-Current Curves for Steel Wire at 60 Cycles.

tance for 30-in. spacing will therefore apply with sufficient accuracy to practically all problems that arise.

Figs. 2, 4 and 8 show the reactance per mile of wire for 60 cycles and 30-in. spacing for the grades of wire and cables most commonly used. These data are the result of experiment and are taken from several sources, and with the exception of 5/16-in. cable the different sources check quite closely.

The life of iron or steel wire depends largely on the conditions under which it is installed. If the wire is located where it can be attacked by coal smoke or chemical fumes it corrodes very rapidly. *E. B. B.* wire probably lasts a little longer than steel wire. The accompanying table gives the average results for all grades of wire.

PROBABLE USEFUL LIFE OF STEEL OR IRON WIRE.

Condition of Installation.	Useful life in years.
Near blast furnaces, smelters, chemical plants, or on the sea coast	1
In large cities where soft coal is used, or near the sea coast	3 to 5
In inland towns where there is little smoke from soft coal	5 to 15
In inland country districts where there is little or no smoke	15 to 25

When an iron or steel wire has served its useful life its scrap value is negligible. Assuming 15 yrs. useful life for an iron wire, 5% of the original investment set aside each year at 5% compound interest will accumulate a reserve equal to the original cost.

Accompanying tables give the sags for steel wire and ordinary galvanized steel wire strand at a temperature of 60 deg. F., which are necessary to secure a factor of safety of 2 for the generally assumed conditions of loading: Namely, 0.5 in. coating of ice, 8 lbs. wind pressure per sq. ft. of projected area, and a temperature of 0 deg. F. These sags are greater than those for copper wire of approximately the same size. The reason for this is that while the tensile strength of ordinary steel wire is practically the same as that of medium hard-drawn copper the copper stretches nearly twice as much for a given tensile stress. Consequently, when sleet collects on the wire the copper stretches more than the steel and reduces the stress in the wire. In other words, the sags for copper and iron will be nearly the same when loaded with sleet, though they are not the same when unloaded.

For current values larger than shown on the curves both the effective resistance and the reactance show a marked decrease. It would be impractical, however, to send current of high value through the wires because of the excessive voltage drop and power loss. For the values of current shown on the curves both the resistance and the reactance drop increase very rapidly with the current, as all factors increase simul-

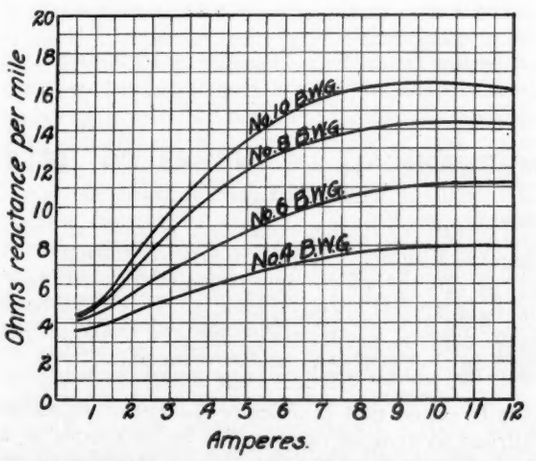


Fig. 4.—Reactance-Current Curves for B. B. Wire at 60 Cycles, with 30-in. Spacing.

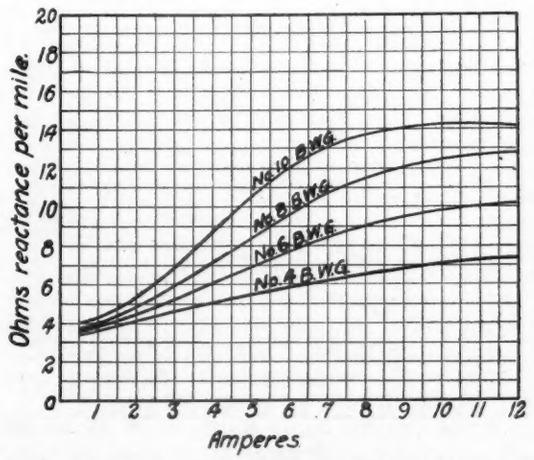


Fig. 6.—Reactance-Current Curves for Steel Wire at 60 Cycles, with 30-in. Spacing.

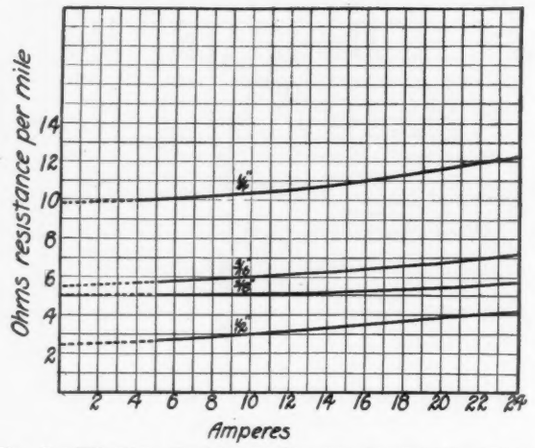


Fig. 7.—Effective Resistance-Current Curves for Steel-Strand Guy Wire at 60 Cycles.

taneously. One important fact to be noted from the curves is that, except for very small currents and very small wires, steel wire has a lower effective resistance and reactance than

SAG TABLE FOR STEEL WIRE.

B. W. G. Wire. Size.	Span in feet. 125	150	200	250	300
	Sag in inches at 60 deg. F.				
8	31	48	92	..	..
6	18	30	60	98	..
4	11	20	41	70	105

E. B. B. or *B. B.* wire. Although steel wire is inferior to the others for the transmission of direct current, yet for alternating current it is better. Its greater tensile strength and lower cost render it decidedly superior to what are

SAG TABLE FOR GALVANIZED STEEL WIRE STRAND. (Ordinary Guy Wire.)

Cable diam. in inches.	Span in feet. 125	150	200	250	300
	Sag in inches at 60 deg. F.				
1/4	10	20	43	72	112
5/16	8	10	22	42	68
3/8	8	10	20	33	55
1/2	8	10	15	27	40

generally called the better grades of wire. For this reason the sag table was computed for steel wire only.

Many engineers have found by experience that copper wires smaller than No. 6 B & S gage have not sufficient mechanical strength to give

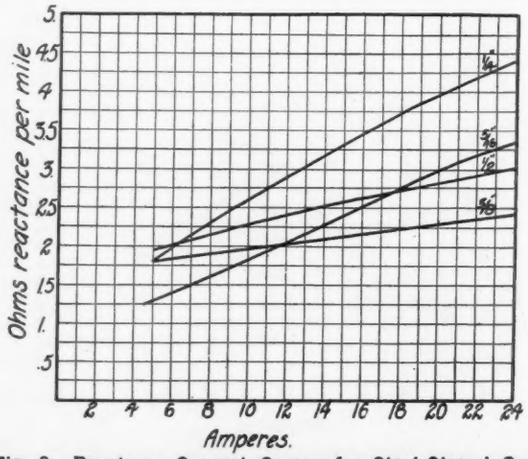


Fig. 8.—Reactance-Current Curves for Steel-Strand Guy Wire at 60 Cycles, with 30-in. Spacing.

reliable service. It frequently happens, however, that No. 6 copper wire is much larger than necessary to keep the voltage drop and the energy loss to sufficiently low values, and in this case steel wire may prove the more economical and have low enough resistance to give satisfactory service.

ELECTRICAL EXTENSION BUREAU OF DETROIT ORGANIZED.

Co-operative Movement Launched to Promote Interests of Electrical Industry—Committee Formed to Work Out Organization Plan.

One hundred wideawake, active men representing all local branches of the electrical industry, having seen what co-operation has done for the other industries in Detroit, decided to apply it to their operations and recently arranged a dinner meeting at the Hotel Cadillac, where with G. G. Beck, of the Federal Sign System, as chairman of the Organization Committee, they did some constructive thinking and talking and decided upon definite action.

Amongst other able speakers, "Bill" Goodwin of the Society for Electrical Development, Samuel A. Chase of the Westinghouse company, and Mr. MacLachlan of the Square D Co., expounded their ideas of the value of the kind of co-operation the Detroit men were advocating and the plans which they had formulated and in every case heartily indorsed them.

The following representative committee was formed to work out the plan of organization decided upon, the details of the campaign and raise the necessary money: H. Shaw, secretary; G. G. Beck, N. J. Biddle, C. C. Cadwallader, J. J. Callahan, Frank Chapman, M. T. Green and A. MacLachlan.

Two electrical homes are to be started and it is estimated that, profiting by the experience gained by other cities in this work, they will cost the Detroit co-operators less than $6000. The different groups will contribute the following amounts—Contractors, jobbers, manufacturers and appliance dealers $700 each, to which the Detroit Edison Co. will add $2800, making a total of $5600, which is expected to be more than enough to take care of the plans at present contemplated.

The name of the new league is indicative of the progressive ideas of its members—Electrical Extension Bureau of Detroit—and the fact that the electrical industry is awakening to its possibilities.

MECHANICAL ENGINEERS TO MEET IN ATLANTA.

Executives of the American Society of Mechanical Engineers have announced Atlanta, Ga., as the city in which that organization will hold its 1922 annual spring meeting. May 8-11 have been selected as the dates for the event. The meeting this year was held in Chicago.

It is stated that practically the entire Japanese railroad system of 8000 mi. is to be rebuilt at a cost of about $200,000,000, says a recent number of the *Far Eastern Review*.

Electrical Operation of Mountain Railways in Switzerland

Extensive Hydroelectric Development Planned to Prepare for Electrification of Main and Branch Lines — Three Types of Operation Necessary to Provide Traction on Varying Grades

The Swiss government has laid out an extensive program of hydroelectric developments to be carried out during the next 20 yrs. It is proposed to electrify important main railway lines within the next 7 yrs., following with the branch roads with the least possible loss of time. Already the developments in hydroelectric systems have been considerable, but many more are projected. A portion of the power developed in the mountains forming the boundary to northern Italy will be sold over the border.

The importance to the American electrical engineer of these projected developments on a large scale lies not only in the peculiar nature of many of the engineering problems involved, but also in the fact that the American market will probably be interested financially to the extent of something like $50,000,000 worth of Swiss government bonds, being issued for the purpose of raising capital to carry out these engineering undertakings.

Brief Review of Swiss Mountain Railway Achievements.

In this connection it may not be out of place to review briefly what has been done and what is likely to be done in the near future in the matter of mountain railways in Switzerland. Tourist lines in the scenic mountain districts are very common, and since the greater number—especially those operated electrically—have proved themselves to be very successful business ventures, it is possible that our own country may see more of them in the future.

The situation has been admirably presented and summed up by M. Gioelet in a paper read by him on July 7, 1920, before the Societé Francaise des Electriciens. M. Gioelet considers the problems and practice of electric traction on steep inclines under three headings which have reference to the three systems that have been used for drawing loads electrically up mountain sides or on steep grades. They are: First, locomotives with simple adhesion; second, rack and pinion systems, and third, funicular, or cable, railways.

Simple Adhesion.—This system is used with success on gradients from 5 to 9%, a common average grade being 7%. For such a grade the locomotive car would weigh about 25 tons and be equipped with four 75-hp. motors. It would carry 44 persons, or a load of about 5 tons, and be capable of drawing two trailing cars, each weighing 7 tons, and accommodating 42 passengers.

Such a train, when fully loaded, weighs about 52 tons and can exert a pull of 12,000 lbs. while traveling at 11 mi. per hr. On the la Gruyere lines, where the grade varies from 3 to 5%, the total weight of the train is 100 tons. The locomotive car carries four 60-hp. motors and weighs 26 tons.

Figures obtained from the operation of existing lines show very conclusively the advantage, from the economical standpoint, of the electric over the steam locomotive. The average cost taken from data of three lines operating by simple adhesion is 2.16 francs per train-mile. One of the factors favoring electric traction, especially where the line starts from a station at a comparatively high altitude, is the difficulty and cost of getting the necessary coal supply for the steam locomotives.

The d-c. system of 750 to 2000 volts, depending upon the amount of traffic and length of line, is very common. The companies of la Gruyere and Montreiux-Oberland use 800 volts d-c. with substations taking power through rotary converters from 3-phase, 8000-volt, 50-cycle hydroelectric primary systems. Secondary batteries are used to equalize the load.

The single-phase a-c. system is more suitable for level lines, but it is used on two Swiss lines with average grades of 1.35 and 2.2% and maximum grades of 3.6%. The 3-phase system is not used in connection with this type of mountain railway.

Advantages of Electricity for Steep Mountain Roads.

Rack and Pinion Lines.—On these lines, which, of course, are of steeper gradient than those employing simple adhesion, both d-c. and 3-phase current are used. The single-phase is not used because the equipment on the locomotive car would be too heavy. The "regenerative" feature of the 3-phase a-c. system has been often referred to as an advantage peculiar to this system. Such, however, is not the case and, moreover, it is not a feature which is practically of great importance in connection with mountain railways of the type under consideration; *i. e.*, which are intended mainly for the use of tourists in the scenic districts but which are also used to some extent for carrying lumber or other products of the districts in which they operate.

In the case of these rack and pinion lines the advantage is again shown to be clearly in favor of electric traction. As an example, the costs per train-mile are given as 8.65 francs for the Arth-Righi line (electric) and 20.30 francs for the Vitzau-Righi line (steam).

The great importance of good brakes is emphasized. As many as four different kinds of brake are used on some of these railways. The importance of a very perfect system of braking, with the necessity of frequent inspection and

periodic tests, together with the high cost of the rack itself account for the high costs both of installation and maintenance of the rack and pinion type of mountain railway.

It is frequently found to be cheaper to follow a longer route and use simple adhesion on a smaller grade. There are many instances where the longer line is justifiable, even at a higher initial outlay because of the greater number of stations which may be included on the system.

Funicular, or Cable Railway.—For reaching the summits of mountains the funicular is the only system available. This type may be used for grades up to and even exceeding 60%, while the rack and pinion type is not suitable on grades exceeding 25%.

The earlier types of funicular road with water counterweights are now obsolete. There are many objections to the use of water, one of these being the difficulties sometimes encountered due to the freezing of the water.

The oldest funicular railway in Switzerland is at Burgenstock, near Lucerne. It was opened in 1888 and operates on a maximum grade of 58%.

The brake universally adopted at the present day on this type of railway consists of jaws which grip the rail. It is usually operated by screws which force the blocks against the sides of the conical rail head. Automatic devices are also provided for operating additional brakes of the same type.

The weight of the cable itself is a very important item on the longer lines. The pull to overcome friction and the difference in weight between ascending and descending cars is furnished usually by a 3-phase induction motor which winds the cable over drums and pulleys about 13 ft. diam.

The largest Swiss funicular railway is the Sierre-Montana-Vermala line, with a total length of something over 2.5 mi. in its two sections. The mean grade is 22.6%, with a maximum of 48.4%.

Mountain railways of the funicular type have proven a great success in Switzerland. In the year 1910 no fewer than 12 new cable lines were inaugurated, the total length covering 10 mi.

In concluding his paper, M. Gioelet sums up the situation in regard to the relative values and uses of the three types of railway by stating that the tendency on lines of small grade is to use simple adhesion and direct current at voltages between 750 and 2000. For steep grades, the funicular type is gaining favor, but the rack and pinion type of mountain railway is being abandoned in favor of either the simple adhesion or the funicular type.

MEXICAN COMPANY TO CONSTRUCT TWO POWER PLANTS.

In an application which the Mexico Light & Power Co. has filed with the Department of Commerce and Industry of the Mexican government for authority to enlarge its hydroelectric system at Necaxa, it is stated that the company plans to construct two additional power plants. Involved in the building of one of the plants is the erection of a dam which will conserve the water for supplying the initial energy. This proposed plant will have a capacity of 60,000 hp., and the project will require 5 yrs. in construction. The second plant or unit will be supplied by water through the existing tunnel at Necaxa. It will have a capacity of about 40,000 hp. The proposed improvements will cost approximately 8,000,000 pesos, which are equivalent to $4,000,000 U. S. money. It is stated that all of the machinery and equipment, which will cost about $3,000,000, will be purchased in the United States.

ELECTRICALLY HEATED LEHRS USED FOR GLASS ANNEALING.

Accurate Temperature Control Results in Uniform Product of High Quality and at Comparatively Low Cost.

By E. F. Collins.

The accurate degree of temperature control through a cycle of temperatures which is necessary in annealing glass, and the difficulty of securing it in the ordinary fuel-fired lehr, have led

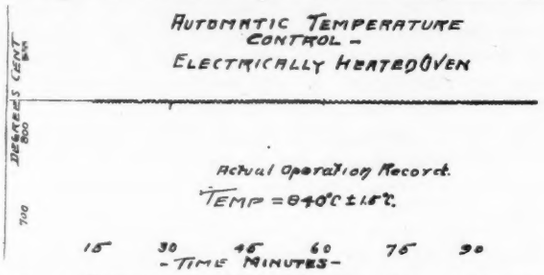


Fig. 1.—Temperature Chart, Showing Close Automatic Regulation of Electric Oven.

to experiments with a view to producing electrically heated lehrs. One such lehr which has been running several months on a high grade of glassware, and on which reliable overall factory costs have been kept, shows a decrease in cost per unit annealed of 20%. This saving is about 75 times the total cost of power for heating the lehr. Generally speaking, the annealing temperature for glass is that constant and uniform temperature at which any stresses which exist are permitted to relax. The length of the anneal—annealing time—depends on the magnitude of the stresses existing before annealing occurs, being a function of each point within the necessary temperature range.

In all glass annealing it is of vital importance that the temperature of the glass mass should be uniform in the annealing range. Temperature gradients in the mass of homogeneous glass under treatment are solely responsible for setting up strains. These gradients may result either from too rapid cooling, or from a nonuniform and uneven heat distribution. Hence the importance of heat control with respect to time, and also proper heat distribution in the lehr through which the glass is passing. Where glass is treated in the box-type oven it is also extremely important that the distribution be good and that the heating equipment lends itself to the exact following of the time-temperature cycle desired, whether it covers a few hours or a month. Preferably, this control should be automatic and correspond to a predetermined cycle; it is for this reason that electrically heated lehrs are successful.

Such automatic control with limits of plus or minus 2.5 deg. C. is available if electrically heated lehrs of proper design are used. Fig. 1 is a time-temperature curve of actual performance on an electric lehr, and the temperature is shown to be held constant within 0.33%.

Fig. 2 is a graphic representation of the time-temperature cycle for annealing fine crown glass for a telescope lens. Such process is best carried on in the box type of lehr in which the lens is placed and subjected to a temperature cycle as shown. With electric heat automatic control is available by means of which this particular cycle or any similar one may be accurately followed and repeated exactly whenever desired. The control instrument is operated by a time-keeping motor supplemented by a simple cam arranged to give different rates of heating or cooling, according to the predetermined characteristic as shown on the curve. Certain tests for fine anneal with this type of apparatus have been made, and reports seem to indicate that results may be obtained that have not been realized with any former method of annealing. These results are not a matter of chance, but may be duplicated repeatedly.

Fig. 3 is a modified type of electrically heated glass lehr which has been installed and working in one of the plants of the General Electric Co. for several months. It has been annealing X-ray tubes, which are a class of ware requiring the best anneal. The results given by this lehr, both in the excellence of anneal and in the decreased number of broken or rejected tubes, have been such as to thoroughly demonstrate its practicality for commercial annealing.

Exact operating costs are not yet available, but from estimates made for such work it is believed that costs will be greatly in favor of the electrically heated lehr, especially when the improved quality of the product, increased production and elimination of rejects are taken into account. The estimate for the vertical type is 10 lbs. of glass per kw-hr. These figures are based on ware entering at 900 deg. F. and being raised to a temperature not exceding 1200 deg. F. A horizontal lehr which would give the same results would occupy a floor space of 70 by 10 ft., being

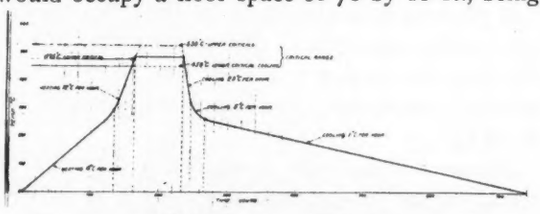


Fig. 2.—Time-Temperature Cycle for Annealing Telescope Lens.

10 ft. high, and its glass capacity would be 600 lbs. per hr. The vertical type would occupy a floor space of 21 by 18 ft. and its glass capacity would be 500 lbs. per hr. The connected loads would be 125 kw. for the horizontal type and 60 kw. for the vertical.

The principal advantages of the electrically heated lehr which contribute to its better operating economy are high thermal efficiency, facility of securing heat distribution, heat control whereby plus or minus 2.5 deg. C. may be secured automatically, and the fact that the annealing time is less than half that required by the fuel-fired lehr. The factors that assist in turning out better products are: First, there is no opportunity for the ware to absorb the products of combustion, hence

Fig. 3.—Electrically Heated Lehr in Plant of General Electric Co.

no sulphuring takes place and the product has a bright, polished surface requiring no washing or cleansing; second, the ware is sterile and absolutely clean due to the heat, which is important for prescription ware, allowing medicinals to be sealed in as soon as the ware leaves the oven, and, last, there is the low temperature gradient which eliminates breakage, distortion and products developing flaws under the tests given after annealing.

ENGINEERS' EMPLOYMENT BUREAU ESTABLISHED.

The Federated American Engineering Societies, representing a combined membership of about 50,000, including the best and most representative professional engineers in the United States, has established at 29 West 39th street, New York City, an employment bureau for engineers of every variety of training and experience.

Applicants must be members and submit a complete educational and professional record which is carefully classified, so that as the special requirements of any positions are received, the records of men of suitable qualifications are submitted for consideration. The relatively large number of men with whom the Bureau is in touch, the comprehensive classification of records, and the fact that the services of the Bureau are free to employer and member alike, renders possible the selection of the right man for the service required. Negotiations may be confidential if desired.

The high standards required for membership in any of the member societies insure the quality of men available, and the Bureau will welcome inquiries from those seeking to build up or expand their engineering organizations in preparation for the increased activity now manifest.

EDITORIAL COMMENT

Seattle's Power Project Controversy

The Skagit river hydroelectric project, undertaken by the city of Seattle, has been the subject of discussion and controversy during the last 2 mo. Dissatisfaction relative to the status of the whole affair culminated about the middle of July in a meeting of the members of the Seattle Chamber of Commerce and a number of civic bodies to consider the matter and give expression to their attitude as a unit. The result was the adoption of a resolution petitioning the mayor and city council to reduce all work on the project to a practicable minimum and to defer the further issuance of bonds until a business, financial and engineering analysis of the entire project shall be made. In the same resolution the mayor and council were asked to join with representatives of the above organizations in selecting a committee of five business men to undertake a survey of the scope recommended.

To this the mayor has replied that adequate surveys and estimates have already been made, and it is understood there will be no cessation of work on the project. The ordinance authorizing the second bond issue was to have been passed on July 25, and there is an evident intention of carrying out the plans. Some of the opposition arises from those of the citizens of Seattle who favor power development by private corporations as against municipal ownership and operation. A still stronger influence in favor of the resolution was exerted by many who demanded an investigation because of the apparent changes in cost estimates by the city engineer and construction engineer. That is, the original cost estimate for the proposed first unit of 37,500 kw. was $5,500,000. Later estimates, in 1919, by outside engineers placed the cost at $5,700,000. But under present plans there is contemplated an expenditure of more than $10,000,000 for the first unit. In relation to the last estimate, however, it should be explained that it is proposed that the construction of the storage dam and the driving of the rock tunnel between the dam and power site shall provide for additional units up to the combined capacity of 112,000 hp. In other words, the initial construction and expenditure are to be not alone for the first unit of 48,000 hp., but for others that may be installed later. Nevertheless the changes noted have given rise to a skepticism in the public mind as to how the whole matter stands.

Of the first bond issue of $5,500,000, the sum of about $3,000,000 has been spent on surveys, borings, temporary construction plant and a 24-mi. line of railroad, and equipment for the first unit, amounting to $1,300,000, has been purchased under contract. Bonds of the first issue, to the amount of $4,875,000, have been sold. These contain the declaration that the proceeds are for the construction of a power plant on the Skagit river at a specified location, and it is maintained they cannot be diverted to other purposes.

The plans and estimates of the project were sponsored and defended before the Chamber of Commerce and other civic organizations by A. H. Dimock, city engineer; C. F. Uhden, project engineer, and J. D. Ross, head of the city lighting department. Outside engineers who were called in 1918 and 1919 in a consulting capacity included City Engineer O'Shaunnessy of San Francisco, D. C. Henny of Portland, and A. P. Davis of the Reclamation Service.

Some citizens apparently want to see the scheme abandoned; others want the work delayed until construction costs are adjusted. But in the minds of the majority the recent move was especially for a more definite financial statement.

One of the reports made earlier in the year by engineers not connected with the city administration was that of W. C. Morse, civil and hydraulic engineer, Seattle. His report dealt with the project in all its phases, and in conclusion he took the position that the water supply and obtainable head on the Skagit river were ample, that it was feasible from an engineering standpoint, but that the cost estimates made by the city engineer may reach only 85% of the actual costs. As to whether the project is a good one from a commercial standpoint, he expressed himself as doubtful.

Many of those who demanded a cessation of work on the project and proposed a re-survey, while admitting the feasibility of the undertaking from an engineering standpoint, seem to regard the expenditure necessary to put it through as unjustifiable under all existing power conditions. The wide range of deviation from the original estimates made others believe there was a good deal of uncertainty as to its ultimate cost.

Engineering Research

We are reminded by a visit from Mr. Ellery B. Paine, Professor of Electrical Engineering at the University of Illinois, of an interesting de-

velopment now taking place in many sections, viz: the utilization of university equipments for the solving of industrial and technical problems. Every one is familiar with the excellent work which has been done by the agricultural experiment stations in their particular field, but until within recent years the engineering schools made no attempt to assist the manufacturing industries in a similar way. Many—in fact, most—of the state schools have magnificent equipments for teaching various branches of engineering—equipments which consist not only of apparatus used in various branches of industrial life, such as boilers, engines, generators, machine tools, motors, etc., but also include accurate instruments for determining the performance of these machines, for carrying out all kinds of measurements and for conducting investigations in any kind of work. The civil engineering department has, as a necessity, a more complete collection of instruments than any private engineer could aspire to, and the mechanical department has at its disposal not only many types of boilers and engines, but completely equipped shops. The electrical departments have instruments and supplies enabling them to make tests and conduct investigations in any line of electrical work. These equipments are needed to instruct the students in their use and to teach them the principles of engineering; but they are also available for carrying out such research work as the members of the teaching staff can undertake.

These fine equipments are now quite generally put at the service of the state for carrying out the investigation of problems which private companies or individuals can less readily undertake. In certain branches of industry the manufacturers have established research laboratories where problems connected with the manufacture of their material, or which may possibly lead to the development of new apparatus and methods, are conducted. This is true notably in the electrical manufacturing business, but such laboratories are relatively few and the results of their work are private—and not public—property. The work of the engineering experiment stations, on the other hand, will undertake investigations for private concerns. In the first case the commonwealth gains directly, while in the latter it gains indirectly since the state must benefit due to any improvement in any industry, and, further, since the fees required for conducting such an investigation will help to support the work of the station.

It is suggested—and with good reason—that wealthy citizens could well afford to grant endowments to state universities, the same as to private institutions, for the purpose of carrying on research work as well as for general educational purposes. In the present frenzied effort to reduce state budgets and keep down taxes state universities are being deprived of funds needed for carrying on the most necessary work; and, if they are to accomplish what modern development seems to demand of them, they must look to private generosity for encouragement and support. This could unquestionably be obtained if the needs of the situation were brought to the attention of wealthy men who might be interested. But, without asking, very little is obtained in this world.

Two Kinds of Tariff Injustice

To say that a man would steal pennies from the blind is to give him a pretty low moral rating; but if certain members of the Ways and Means Committee in the House of Representatives at Washington have their way in framing our next tariff law, we shall all be living under a government which systematically robs the blind as one means of raising its revenue.

Previous administrations have levied tariffs on new books, but they have always made certain exceptions. Books over 20 yrs. old have been exempt, as well as books for schools and libraries and books in raised lettering for the blind. In the new tariff bill all these exemptions will be swept away. Blind people, who have few books they can read, anyway, and who have to pay a high price for them on account of the raised lettering, will be assessed 20% more.

This is the worst feature of a tariff provision that bears down very heavily on all who import technical works from other countries. The provision as a whole has no redeeming feature. Even on the theory of protection it does not protect, for no American authors or publishers are, to any appreciable extent, competing with these books.

Many such technical works are imported in editions as small as 250 copies, and to manufacture them in this country would be commercially impracticable; yet these books may be of the greatest value to specialists and in educational institutions. The new tariff simply robs such institutions, as well as libraries, of a large share of their book appropriations, or deprives the individual buyer of a book altogether by making it too expensive for him to buy or even for book handlers to import.

It hardly seems possible that the legislators who are framing this tariff are deliberately robbing the blind man of his reading matter or the student of his text books. Probably to them a book is just a book—something which they seldom use themselves but which makes a handy birthday or Christmas gift or is bought by the yard to adorn their home libraries.

There also appears to be a method proposed of

assessing the duties on foreign books which, apart from the size of the duty itself, makes it almost impossible for book handlers to import them with success.

One could only understand the policy of the tariff makers in placing duties on the classes of publications which are now to be penalized as a deliberate attempt to prevent the reading of books which have been tainted by ocean travel. As there would hardly be any such motive as that, pure imbecility must be to blame.

The government has, however, already practiced deliberate sabotage of educational matter by its zone postage rates on technical periodicals and nothing that Congress does in the present instance can be any more surprising than the crimes already committed in that direction. It is time for the public to protest and to make its protest felt. Never having been organized into a soviet we hardly know how to go about making the desired impression on Congress. Perhaps some of our readers have a solution. If so, we shall be glad to hear from them.

Quite the opposite of the above situation is the treatment of the subject of tariff on drawing instruments used by engineers, architects, commercial artists and technical schools.

For many years prior to the war Germany was the principal source of supply for most of the drawing instruments used in the United States. When hostilities between the two countries caused a suspension of commercial relations between them it became necessary for the United States to produce its own drawing instruments, the need for which was imperative owing to the greatly increased demands made on drafting rooms for working drawings of war material.

Manufacturers in this country endeavored to meet this emergency by installing machinery for the manufacture of drawing instruments and, aided by "Yankee ingenuity," improvements were made that resulted in drawing instruments being produced in this country that are unequalled for accuracy and finish. This infant industry, furnishing a fresh field of endeavor for the American artisan, is now threatened by the resumption of commercial relations with Germany, which, in an endeavor to win back her trade in this line of manufacture, is flooding this country with drawing instruments at prices that it is impossible for the American manufacturer to meet.

Two conditions handicap the American manufacturer of drawing instruments in competition with German manufacturers; first, the more liberal wage scale prevailing in this country, and second, the difference in the value of the currency of the two countries, the German manufacturer being able to make a good profit on his exports when the American dollars he receives for his goods are exchanged for the very much depreciated marks with which he pays his workmen for their service.

Prior to the war the duty on drawing instruments was 25% ad valorem, and under the new tariff bill now pending in Congress the proposed duty is only 40%, an increase wholly inadequate to offset the handicaps under which the American manufacturers of drawing instruments labor. If this infant industry is to be saved and American workmen engaged in it continued in their employment, the duty will have to be at least 60% ad valorem.

While such a duty might be onerous in the case of an article of general and everyday consumption it should be remembered that the market for drawing instruments is limited, that a good set lasts a lifetime and that even with a 60% duty in their favor American manufacturers of drawing instruments will have difficulty in meeting the desperate competition of German manufacturers who are leaving no stone unturned to win back a market which, prior to the war, was practically a German monopoly.

Advertising to Retailers

How intimately do manufacturers know some of their dealers, asks *Printers' Ink*. How recently have they talked with dealers about their present problems? Do they realize how definitely the retailer needs helpful instruction in the matter of true figuring of retail profit? A reading of the journals of retailers in various lines shows that the number of manufacturers who are talking in terms of real profit is far smaller than it should be. One manufacturer has said that retailers are ordering little enough now, without telling them in vigorous terms about small orders and quick turnover. Yet an argument which is vastly more forceful than anything which can be said about the excellence of the goods is in many cases being overlooked.

Instead of trying to sell more merchandise in this market, it would be better to sell the retailer a definite plan which will move the manufacturer's merchandise from his shelves. Many manufacturers have evolved or are working out such plans, but the number is exceedingly small in proportion to the possibilities. Fire sales, fake bankrupt sales, loud noises, wild stunts—the time for these, if there ever was a time, has definitely and finally passed.

A careful reading of the business publications, a receptive attitude toward real selling ideas and the ability to adopt them and pass them on, will do more to bring business back to a normal condition than any number of inspirational appeals or speeches.

THE WEEK'S NEWS

Reports of Important Meetings, Developments and Other Happenings of the Electrical Industry and Its Allied Interests

N. E. L. A. ANNOUNCES COMMITTEE CHAIRMEN.

George F. Oxley, director of publicity of the National Electric Light Association, New York City, advises as follows: "President M. R. Bump announces the acceptance by S. Z. Mitchell, president of the Electric Bond & Share Co., New York City, reappointment as chairman of the Public Policy Committee; Alex Dow, president of the Detroit Edison Co., reappointment as chairman of the Rate Research Committee; John F. Gilchrist, vice-president of the Commonwealth Edison Co., Chicago, appointment as chairman of the Customer-Ownership Committee, and G. C. Neff, general superintendent of the Wisconsin Power, Light & Heat Co., Madison, Wis., appointment as chairman of Rural Lines Extension Committee."

PENNSYLVANIA ASSOCIATION WILL MEET NEXT MONTH.

Super-Power Survey as It May Affect Pennsylvania Among Principal Subjects to Be Discussed at Bedford Springs Meeting.

The 14th annual convention of the Pennsylvania Electric Association—a state branch of the National Electric Light Association—will be held at Bedford Springs, Pa., Sept. 7-10. There will be morning and afternoon sessions, except on Saturday, when the final session will be held in the morning. The program opens on Wednesday evening, Sept. 7, with the reception to the president. The chief features on Thursday morning will be the address of President Henry Harris, Wilmerding, Pa., the appointment of auditing and nominating committees, and a paper on "The Super-Power Survey as It May Affect Pennsylvania," by Harold Goodwin, Jr. The afternoon session will be a commercial meeting with a number of interesting reports and papers. The Technical Session will be held Friday morning, Sept. 9, while the Accounting Session will be held on the morning of Saturday, Sept. 10. Prominent speakers will address the Public Policy Session Friday evening, Sept. 9.

A feature of the entertainment will be furnished by the Westinghouse Electric & Manufacturing Co. Each evening the Westinghouse band will play at Pittsburgh and the concert will be reproduced by means of the radiophone at Bedford Springs. Following this the delegates will listen to the performance nightly as given in the Davis theater, Pittsburgh. In addition, stock quotations, sporting news and other matters of interest will be supplied daily.

The officers of the Association are: President, Henry Harris, Wilmerding, Pa.; first vice-president, A. H. S. Cantlin, Allentown, Pa.; second vice-president, Ernest H. Davis, Williamsport, Pa.; treasurer, H. H. Ganser, Norristown, Pa., and secretary, Henry M. Stine, Harrisburg, Pa. The Executive Committee consists of John S. Wise, Allentown, Pa.; H. R. Palmer, Harrisburg, Pa.; Henry Muller, Pittsburgh; W. E. Long, Philadelphia; G. M. Gadsby, Pittsburgh; J. H. Shearer, Altoona, Pa., and W. R. Kenney, Pittsburgh.

William K. Kerford.

Philadelphia Electric Co., who will have charge of entertainments at the Bedford Springs convention of the Pennsylvania Electric Association.

A. L. Atmore is chairman of the Program Committee, and W. H. Evans is chairman of the Publicity Committee, both being located at 1000 Chestnut street, Philadelphia. Mr. Evans, in sending out the announcement of the convention, states that "nowhere in Pennsylvania could the Pennsylvania Electric Association have selected a more delightful place for its 14th annual convention than Bedford Springs, situated as it is 1300 ft. above sea level and 2 mi. from the historic town of Bedford, through which runs the Lincoln Highway. The hotel, the largest summer resort in Pennsylvania, is able to take care of more than 400 guests and the 9-hole course adjoining the hotel is one of the best links in the state. Convenient to the course is the white-tiled swimming pool."

CELEBRATE LIGHTING ANNIVERSARY

The city of Buffalo, N. Y., celebrated the 40th anniversary of its electric street lighting system on July 13. The first lamps were cut in on this date, 1881, consisting of seven lamps on Ganson

street. The installation cost the city $5000 a year and was made by the Brush Electric Light Co. The succeeding company, the Buffalo General Electric Co., was organized in 1892 with a capital of $1,900,000.

MANY ELECTRICAL DEVICES SHOWN AT PAGEANT OF PROGRESS.

Every Booth and Exhibit Requires Electric Service in One or More Forms—Latest Devices and Appliances Demonstrated.

Electricity plays a modest but all-important part in the great Pageant of Progress Exposition now under way on Chicago's municipal pier. Many booths are devoted exclusively to the display of electrical products and services, but the important feature to the electrical industry is the fact that electricity plays a prominent part in every one of the 1000 displays. Aside from the general lighting all booths are provided with local lighting to meet the particular needs of the individual display. The booth occupied by the Wholesale Millinery Association of Chicago is provided with colored flood lighting equipment to properly set off the products on display. This booth should prove to be as interesting to the electrical man as it is to the millinery dealer, or to the woman interested in the "latest thing" in hats.

An attractive window lighting arrangement is employed in the display of Phoenix hosiery. The reflectors employed in this exhibit are concealed behind a window drape, and a high intensity of uniform illumination is provided. The result is quite satisfactory, as may be noted by watching the crowds attracted and held before the window. The application of motor power in the hosiery manufacturing industry was shown in a neighboring display where a machine was in operation weaving "Holeproof" stockings. Other weaving operations, including the production of gold mesh bags and hand towels, carried on by means of electric power, were demonstrated in other spaces.

One of the things to be noted was the quite general use of motor operated display novelties of all kinds. It was pointed out by those in charge of exhibits that the moving objects attracted the attention of visitors, and that this attention was then diverted to the real products on display. Toy trains, sometimes empty and sometimes loaded, appeared to be the most popular of such equipments. However, the booths showing various electrical appliances seemed to have a decided advantage in the fact that their moving displays represented the real products which were intended to be shown to the public. Crowds were always gathered around the washing machines, cleaners, ironers, dishwashers, fans, blowers, and other moving electrical devices.

Much interest was displayed in the silk weaving machines and in motor-operated sewing machines employed in the production of corsets and other items of clothing. The box-making machinery attracted much attention, although it was questionable whether the greater attention was centered in the moving machinery or the clever operators feeding it. Many people showed a keen interest in the various domestic refrigerating equipments shown. The motor-operated model packing plant attracted an endless line of curious visitors. In this display was shown the complete route through which meat products pass from the receiving pens in the stockyards to the retail shop where the consumer makes his purchase. Conveyors, elevators, etc., were all driven by motors, and miniature electric lights were used to illuminate the interiors of the various model buildings.

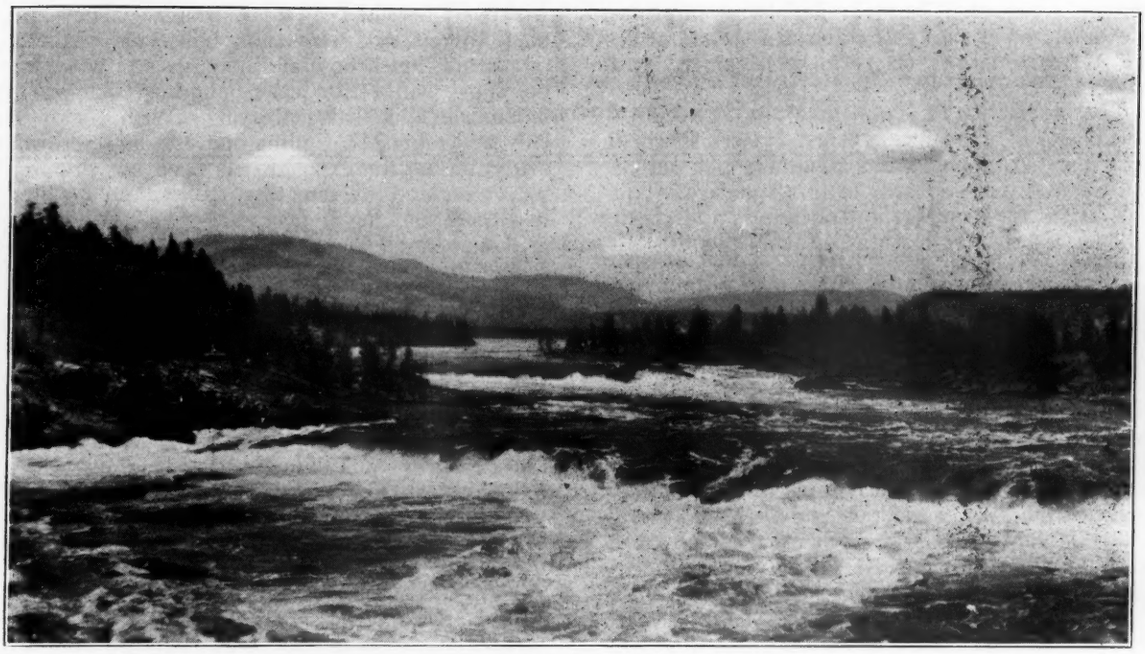
Public Utilities Have Exhibits That Attract Much Interest.

The Commonwealth Edison Co., Chicago Surface Lines, Public Service Co. of Northern Illinois, Illinois Bell Telephone Co., Chicago Elevated Railways Co., and Chicago, North Shore & Milwaukee Railroad Co., each had an interesting exhibit showing the services rendered to the public. The Commonwealth Edison display showed progress in station construction and progress in the utilization of power for both lighting and mechanical service. It also contained an array of domestic utility devices of almost every description. An illuminated map of the territory served was a prominent feature of the exhibit of the Public Service Co. of Northern Illinois. The transportation companies displayed features of their service that are of general public interest, a moving picture being used in one instance.

A model switchboard shown by the Illinois Bell Telephone Co. attracted much attention, and the display of telephone parts and equipment by the Western Electric Co. proved of great interest. The Western Electric Co., in addition to showing this telephone equipment, had on exhibition a variety of domestic appliances.

The General Electric Co. occupied a considerable space with a collection of equipment showing certain steps in the progress of the industry. One display showed the history of illumination from the earliest days to the present time. Among the larger equipments shown was a complete welding set in actual operation. A screen shielded the visitors who observed the operations through small glass windows.

Illustrations Showing Progress in the Development of Artificial Illumination.



Power Site on Columbia River Just Purchased by Washington Water Power Co., Spokane, Wash.

Floor and table lamps, woodworking tools, meat grinders, ventilating fans, laundry equipment, fire pumps, automobiles, phonographs, and a great array of other electrically operated equipments were to be seen in the various booths. The Harter Manufacturing Co., who supplied the fixtures used on the pier, had a display of industrial lighting devices, and the Hub Electric Co. and Henry Newgard & Co. represented the contracting branch of the industry. A fine display of radio equipment was made by the U. S. Navy and others interested in this type of communication. The show is too big to describe, so we must say—go and see it and then boost for electricity, the agency that made the exposition possible.

KETTLE FALLS ON COLUMBIA RIVER TO BE DEVELOPED.

Washington Water Power Co. Purchases Site for Future Erection of Hydroelectric Plant of Ultimate 130,000-Hp. Capacity.

The Washington Water Power Co., Spokane, Wash., has purchased the water power site at Kettle Falls on the Columbia river after having made an engineering investigation earlier in the year. The falls and rapids are in Stevens county, 75 mi. northwest of Spokane. The river at this place makes a descent of about 35 ft., and it is estimated that by the construction of a dam there may be developed a head of 75 ft. According to preliminary estimates the volume of water at low stage is sufficient ultimately to develop 130,000 hp. This power may be developed in successive stages, beginning with a 25,000-hp. unit, so that in bringing about complete development of the site the financial burden involved may be distributed in accordance with the increasing demands for power.

This company's several existing hydroelectric plants are situated on the Spokane river at Spokane, Post Falls and Long Lake, where low water occurs several months earlier than on the Columbia river. This fact makes an alternative source of power on the latter stream particularly advantageous.

It is announced by D. L. Huntington, president of the company, that the first stage of development at Kettle Falls will be undertaken as soon as power demands require it. Other than this no plans have been given out at this time. The contemplated demand for power to pump water for irrigating valley and bench land along the Columbia river in that part of the state is one that is considered promising.

The purchase of the Kettle Falls site was made from the Granby Consolidated Mining, Smelting & Power Co. which formerly operated a smelting plant at Grand Forks, B. C. The accompanying illustration shows the upper and lower falls on the main channel as they appeared in June, 1921.

S. E. D. ISSUES TWO BOOKLETS OF PUBLICITY MATERIAL.

The Society for Electrical Development, Inc., 522 Fifth avenue, New York City, has issued two booklets, viz.—"Facts About the S. E. D." and "The Society for Electrical Development, Inc.—Its Activities and Aims," which are the forerunners of standard sized publicity material that the Society intends to produce. These two are written for the special purpose of giving prospects a concrete idea, in easily read form, of what the Society is, does, can do for them and will do as time goes on and facilities improve.

"Facts About the S. E. D." consists of twenty-four 3 by 5 in. cards, each taking up one phase of the Society's organization, or the functions it performs. These cards will be added to from time to time. They are perforated and may be detached and filed, and they represent the Society's start of a ready reference 3 by 5 in. card

system which will be continued not only for membership solicitation, but for supplying informative data, and as the basic material for the Speakers' Bureau of the Society to be organized at a later date.

The other booklet is the first of the Society's standard size, 6.25 by 9.25 ins. (insert sheets 6 by 9 ins.) pamphlets, and all others put out by the Society will conform to this standard. This one also is for membership solicitation and sheets will be inserted as material of value in this direction is prepared.

I. E. S. ARRANGING PROGRAM FOR ROCHESTER MEETING.

The 15th annual convention of the Illuminating Engineering Society will be held in Rochester, N. Y., Sept. 26-29, with headquarters at the Powers hotel. The Committee on Papers is arranging a program which offers a wide variety of scientific and commercial subjects, indicating that this convention will maintain the high technical standard established at previous conventions.

While technical consideration of lighting matters will dominate the convention, some time will be left for inspection of Rochester's interesting industries and for recreation and entertainment. Special provision is being made to make the visit of ladies enjoyable and interesting, according to the announcement sent to the membership by President George H. Harries under date of Aug. 1.

FRENCH RAILWAY BUYS AMERICAN EQUIPMENT.

An order for electrical equipment amounting to $1,200,000 has been received by the Westinghouse Electric International Co. from the Midi railway of France. The order includes transformers, synchronous condensers, lightning arresters and other substation equipment. The Midi railway operates an extensive system starting from Bordeaux, running through Toulouse to Cette, with many branches. The section on which the Westinghouse equipment will be used extends from Pau to Toulouse in the Pyrenees mountains near the Spanish border. The line passes through Tarbes and St. Gaudens, and has a total length of over 100 mi.

HEARINGS ON LIGHTING RATES.

The State Department of Public Utilities of Massachusetts has inaugurated a series of hearings relative to the present rates of the Edison Electric Illuminating Co. of Boston for light and power. The petitions filed with the department cover 38 municipalities in that section. Street lighting rates at Boston will also be considered at the hearings.

ELECTRIC WHIP HOLDS ATTENTION OF PAGEANT CROWD.

In the mammoth booth of the Commonwealth Edison Co. in the Electrical Section of the Pageant of Progress Exposition, Lathrop Collins holds forth in a generous space with demonstrations of his "electric whip." Mr. Collins is the head of Kollins Kitchen-Kraft appliances. The "electric whip" is a rotary egg beater to which is attached a small motor. They are made in various sizes for household, bakery, restaurant, lunchroom and hotel uses in whipping up eggs, batter for cake, puddings, etc., and other dishes like salad dressing. With a staff of lady assistants Mr. Collins interests large crowds every minute the exposition is open by whipping up some kind of tempting dainty and cooking it—where cooking is necessary—with an electric grill and small aluminum oven. And they are selling like hot cakes.

ELECTRICAL ENGINEERS TO MEET.

The annual convention of the West Virginia-Kentucky Association of Mine, Mechanical and Electrical Engineers will be held in Huntington, W. Va., Sept. 20-23. Meetings will be held in the Chamber of Commerce building, in which there will also be the exhibits of the Coal and Industrial Exposition.

COMING CONVENTIONS.

Pageant of Progress Exposition, Municipal Pier, Chicago, July 30-Aug. 14.

Michigan Electric Light Association. Annual convention, Ottawa Beach, Mich., Aug. 24-25. Headquarters, Hotel Ottawa. Secretary, Herbert Silvester, Ann Arbor, Mich.

New England Geographic Division of the National Electric Light Association. Annual convention, New London, Conn., Sept. 6-9. Headquarters, Hotel Griswold. Secretary, Miss O. A. Bursiel, 149 Tremont street, Boston.

International Association of Municipal Electricians. Annual convention, Colorado Springs, Colo., Sept. 6-10. Secretary, Clarence R. George, Houston, Tex.

Pennsylvania Electric Association. Annual convention, Bedford Springs, Pa., Sept. 7-10. Secretary, Henry M. Stine, 211 Locust street, Harrisburg, Pa.

Great Lakes Geographic Division of the National Electric Light Association. Annual convention, French Lick Springs, Ind., Sept. 14-16. Secretary, R. V. Prather, 305 De Witt Smith building, Springfield, Ill.

Indiana Electric Light Association. Annual convention, French Lick Springs, Ind., Sept. 14-16.

Association of Iron and Steel Electrical Engineers. Fifteenth annual convention, Chicago, Sept. 19-24. Headquarters, Hotel La Salle. Secretary, John F. Kelly, Empire building, Pittsburgh.

West Virginia-Kentucky Association of Mine, Mechanical and Electrical Engineers. Annual convention, Huntington, W. Va., Sept. 20-22. Secretary, Herbert Smith, 212 Robson-Pritchard building, Huntington, W. Va.

Illuminating Engineering Society. Annual convention, Rochester, N. Y., Sept. 26-29. Headquarters, Powers hotel. General secretary, Clarence L. Law, 29 West 39th street, New York City.

American Electrochemical Society. Meeting at Lake Placid Club, N. Y., Sept. 29-Oct. 1.

New York Electrical Show, 71st Regiment Armory, Park avenue and 34th street, New York City, Sept. 28-Oct. 8. General manager, George F. Parker, 124 West 42d street, New York City.

Cleveland Section of the American Society of Mechanical Engineers. Great Lakes regional meeting, Cleveland, Oct. 3-4. James Guthrie, Fidelity building, Cleveland.

Southeastern Geographic Division of the National Electric Light Association. Annual convention, Chattanooga, Tenn., Oct. 18-20. Headquarters, Signal Mountain Inn. Secretary, Charles A. Collier, Electric and Gas building, Atlanta, Ga.

OPERATING PRACTICE

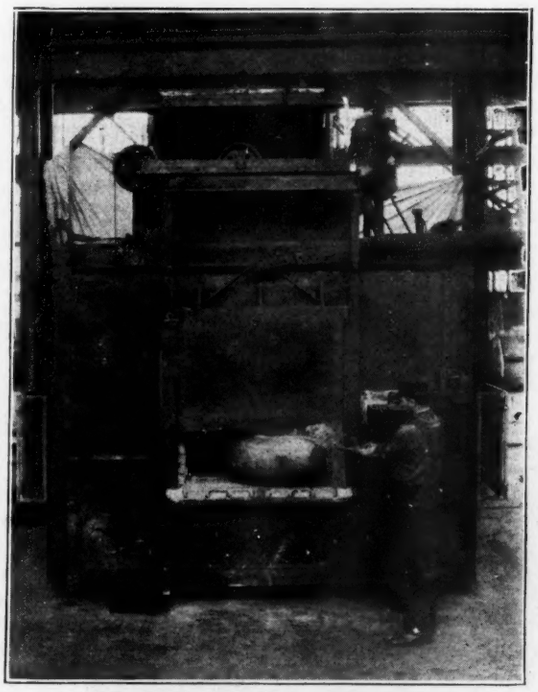
Methods and Problems Embracing Operation and Installation of Power-Plant Equipment and the Distribution of Electrical Energy

PORTABLE ELECTRIC FURNACE USED TO HEAT SHEET METAL.

Uniform High Temperature Obtained Without Damage to Light Material Employed in Manufacture of Automobile Bodies.

In the manufacture of automobile-body and fender stampings it is of considerable importance that the heating operations be conducted with as little scaling as possible, for any pitting due to this action requires additional labor in getting the defects removed to sufficient extent to get a good finish on the part. The Mullins Body Corp., Salem, O., with this in mind recently installed in its new plant a Baily electric furnace specially designed for this work. Since a large part of the pressing or drawing to shape is performed cold, and only one or two hot runs are required for perhaps six or seven cold operations on the press, it was desirable to build a furnace of the portable type which could be handled by a crane and taken from place to place so that there would be no idle furnaces while the material was receiving its cold runs. This necessitated a furnace with four eye-bar connections at the top—one at each corner—for hooking on the crane chains, and also that the transformer and control equipment be located on the top of the furnace.

The furnace is rated at 100 kw. in electrical capacity and has a hearth 3 ft. 4 ins. wide by 6 ft. 5 ins. long with a door opening 3 ft. 4 ins. wide and 2 ft. 2 ins. high. It has a capacity for heating 750 lbs. of material to 1800 deg. F. per hr. In plants where a crane is not available for moving the furnace the equipment is designed for mounting on a car which may be moved at will on a track running parallel to the battery of presses. One of the notable features of this equipment is the remarkable uniformity of temperature obtained on the sheets, a condition which is not possible to attain with fuel-fired equipment where the doors must be opened so frequently. Scaling is also reduced to an almost negligible item, making much smoother sheets than is possible in fuel-fired practice.



Portable Electric Furnace With Transformer Mounted on Furnace Structure.

CENTRAL-STATION SERVICE FOR AN INDUSTRIAL PLANT.

Abstracts From a Paper Presented Before Illinois State Electric Association—Consideration of Points in Matter of Costs.

By JOHN H. MITCHELL.
East St. Louis Light & Power Co., East St. Louis, Ill.

Power service is not sold on generalities, although more and more of it is being purchased without detailed study as a result of crystallization of opinion in its favor. Costs, in the end, determine whether or not any given commodity or service shall be used, and if a substitute of lesser cost and equal utility is found for a certain service that substitute is bound to attain favor. However, services such as are supplied by a central station or an isolated power plant are complicated as to cost determinations, and well-prepared estimates are often found to depart somewhat from actual conditions found in operation.

In order to make an estimate of service costs it is necessary to take up the various separate elements and consider them one at a time. The following brief comments touch on these various elements:

Investments.—The question of power plant investment and the cost of carrying it is one that is receiving much more consideration from power users than it was a few years ago. It is realized today, for example, when the cost of permanent financing is around 10%, that a conservative figure for fixed charges, including interest, depreciation, taxes and insurance is quite likely to run in the neighborhood of 20%.

Such an investment is, of course, useless except for the purpose for which originally made, while land, building, machine tools, etc., representing the capital of an industry, can frequently be converted to other purposes if necessary. For example, many plants engaged in ordinary lines of manufacture were turned into munitions plants during the war, and many specially constructed munitions plants have become the home of commercial production since the signing of the arm-

istice. This easy conversion to other duties is not true of the small power plant which is one of the least liquid forms in which an industry can tie up its money.

From an engineering standpoint such an investment for a given manufacturing industry, if made with a view to future growth, is likely to be too large at first for economical operation. When the growth of the industry finally overtakes it and the plant reaches the point where it can produce power at a minimum possible cost for the class of equipment in use, it will have such a small marginal capacity that subsequent growth will be hampered by lack of power facilities until this capacity can be increased. The normal growth of a given industrial plant, neglecting variations due to periods of depression or prosperity, may be represented by a line constantly rising as it is extended. The increase in size of a power plant designed to supply it will then be represented by a series of alternate horizontal and vertical lines crossing and recrossing the general growth curve of the manufacturing plant.

The matter of investment should always be seriously considered, but particularly today under the condition of high cost of money. The central-station company is also faced with difficulties due to the high cost of financing, but, fortunately, any investment that it is necessary to make today is only a percentage of the total investment. On the other hand, the industry that builds an isolated plant today must make its whole investment at a high point in cost of both equipment and money.

Fuel.—It is much easier to establish a realization in the mind of the power user of the actual cost of fuel per unit of net power produced in a plant that is now in operation than in a prospective plant because simple tests, if records are not available, will establish the actual number of pounds of coal that must be purchased to turn out a kilowatt hour equivalent in power.

Curiously enough there are still to be found people who think in terms of manufacturer's guarantees of efficiency of individual apparatus rather than in terms of overall efficiency attained by that apparatus when assembled together in a power plant and put into actual operation. There are a great many more plants turning out a kilowatt hour on 8 lbs. of coal than there are on 2 lbs.

We may state here that a good deal of misconception exists of the relation that heating service bears to power production costs. The use of a steam engine or turbine as a reducing valve between the boiler plant and the heating system is very pretty in theory, but a comparison of heating load curves with power load curves will usually reveal the fact that they are not coincident. Consequently we find plants designed to operate in connection with heating service where the engines are acting as reducing valves between the boiler and atmosphere for a large portion of the 24 hours. and have to be supplemented by live steam through actual reducing valves during the balance of the time. This fact, taken in connection with the shortness of the heating season, should be given due consideration.

Wages.—Labor is always a large item in the cost of isolated plant operation and is practically constant regardless of the power output for a given plant with a given period of operation per day. Wages have the same relation to cost of power production under these conditions as fixed charges, which means that in times of depression when power output is at its lowest figure these elements of fixed investment charges and nearly fixed operating charges tend to cause an extremely high cost per unit of output. The use of central-station service does not present this disadvantage to so great an extent, as demand charges are based almost entirely upon investment while energy charges cover all operating expenses. Thus the total cost varies more nearly in proportion to the amount of energy used, and therefore will vary more nearly in accordance with the activities of the industry.

Supervision.—It is probable that the full cost of supervision seldom gets charged against an isolated plant to the extent it should be charged, just as most side lines of endeavor fail to carry their full quota of overhead expense, but in every manufacturing plant the responsibility of keeping uninterrupted streams of coal flowing up to the stokers and of holding the human organization of the power plant together has certainly taken the time of high priced men whose abilities would have produced a greater return if directed entirely to that line of production for which the industry is in existence. In small plants where a single executive has had to shoulder all of these responsibilities, he should have even a keener appreciation of the difficulties outlined above than has been stated.

Water.—The cost of water for steam and condensing purposes follows closely the increased cost of fuel and labor if pumped locally. If purchased, the cost can easily be determined. Cost of treatment, etc., should not be overlooked in dealing with it.

Supplies and Maintenance.—The cost of supplies and maintenance is usually difficult to secure on a plant that is in operation, and equally hard to determine in detail for a proposed plant. A few years ago the combined items could be estimated on the basis of 5 to 8% annually of the original cost of the plant as an average figure applying over a period of years. These costs, however, have gone up materially, and if handled on a percentage basis should be estimated for plants existing in 1914 at about twice the figure given above.

As stated previously, it is difficult to handle the subject of cost comparison unless applied to a specific case, but we may always bear in mind that the success of the central station depends very much upon the same factors that have brought success to other large industries.

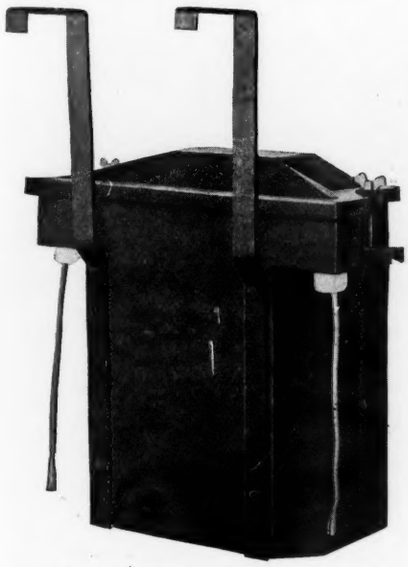
The fact that industrial managers of the country who are using *the service* are boosters for it, and many of those who are not using it will actively consider it at the earliest opportunity, is an indication of the place the central-station company fills in the community. This general situation readily opens the way at the opportune moment to negotiation for sale and purchase of service, but the consummation of that sale must be based upon a real and continuing advantage to the purchaser as a result of the transaction. In other words, service must be sold not merely for today or tomorrow, but for years to come.

APPLIANCES and DEVELOPMENTS

New, Improved or Interesting Electrical and Mechanical Apparatus and Devices, and Applications of Equipment and Methods in Practice

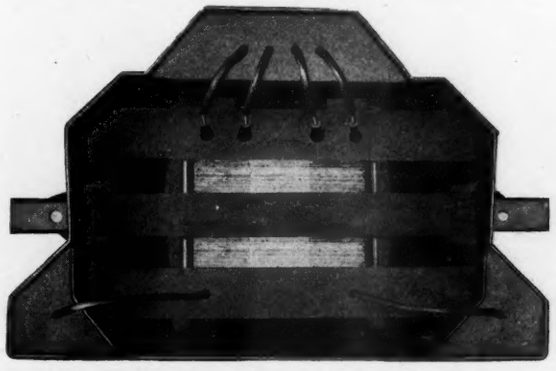
"Peerless" Transformers with New Type of Case.

Utilization of a pressed steel case is the latest improvement to be made in the construction of "Peerless" transformers by the Enterprise Electric Co., Warren, O. The adoption of this new type of construction results in a material reduction in the weight of the finished unit with corresponding reductions in transportation and handling costs. Greater ease of installation and greater mechanical strength are features of importance claimed for this type of construction. Hanger irons are permanently attached to the plain cases to eliminate the need of handling these devices separately. Corrugated cases are provided with a substantial wrought iron base which forms a support for the tank. At present a cast iron collar and cover are provided, but it is intended soon to supersede these parts with parts of pressed steel.



Back View of "Peerless" Transformer in Steel Case.

All leads coming through the case are brought out through substantial porcelain bushings. Attention is given in the design and construction of the windings to secure a proper balance both electrically and mechanically. Thus, lightness of weight, strength, durability, and good operating qualities are the factors aimed at in the production of this equipment.



Top View of "Peerless" Transformer With Cover Removed.

Labor Saver for Salesmen of Electrical Appliances.

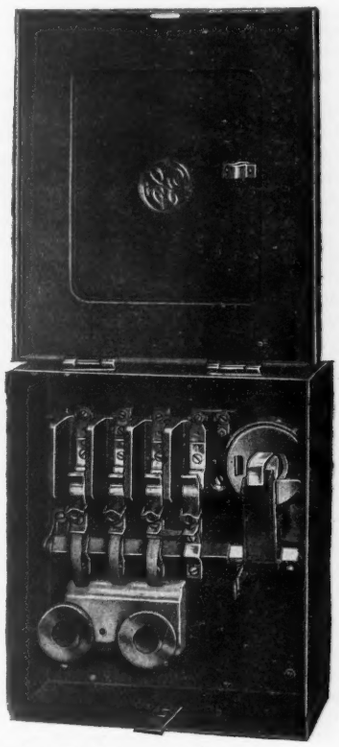
The P. A. Geier Co., Cleveland, manufacturer of the "Royal" electric cleaners, has published in a recent issue of its house organ an article on a labor saver for salesmen of electrical appliances entitled "New Automatic Royal Demonstrator."

A salesman of the Schneider Electric Co., Detroit, is the one who perfected this device and has used it with great success. His plan is simply to have a motor do all the work while he does the talking and wields the order book. The device, as worked out by him, simple and easy to construct, consists merely of a box 7 or 8 ft. long, 18 ins. wide and perhaps 2 ft. deep. The top of the box is open and four rollers are so arranged that two endless belts made of carpet fill the opening. These carpet belts are kept taut by tension rolls within the box, and are made to run at equal speed in the same direction by a motor belted to the rolls. To one of the carpets he glued various kinds of dirt, lint, and litter—the other carpet is immaculately clean. The "Royal" cleaner is so placed that its nozzle fills the crack where the two belts meet. In operation its effect is like a continuous strip of carpet running from end to end across the top of the box—dirty and covered with rubbish until it reaches the nozzle of the "Royal" cleaner and perfectly clean after it has passed.

This mechanical demonstration has the necessary qualities of interest, motion and emphasis on the article for sale, to insure sales-making results. It causes people to stop, look and wonder. Curiosity is aroused so that they go into the store and make inquiries, and it is then that the salesman gets busy and does his part by explaining and selling the appliance that has been so cleverly demonstrated.

Inclosed Starting Switch for A-C Motors.

An improved type of inclosed magnetic starting switch for small a-c motors, known as the C.R. 7005 A-2 switch, has recently been developed by the General Electric Co. They are for use with motors of from 3 hp., 110 volts up to 5 hp., 220, 440 and 550 volts. The switches are suitable for use with momentary contact start and stop push-button stations, or snap switches, float switches, pressure governors, thermostats, etc.



Motor Starting Switch in Inclosing Cabinet.

The apparatus consists of an operating magnet, contactor, and protective plugs, all mounted on a sheet steel base and inclosed in a case with a cover hinged at the top. The operating magnet is wound for full line potential, is waterproof, and easily removable from the front. The contacts are heavy copper, backed by helical springs which hold them tightly in place, and make them capable of very frequent service for a long time.

The protective device is in the form of two removable inverse, time element, protective plugs, which safeguard the motor against overloads ordinarily met in service. When used with momentary contact push-button stations these switches provide undervoltage protection, as the motor cannot be restarted when stopped by voltage failure until the start button has been pressed. When

used with snap switches, float switches, etc., they furnish undervoltage release, permitting motors to restart immediately on the return of voltage.

The switch is very easy to install, being provided with three knockout holes at the top and two at each side for 0.75-in. conduit. They also have holes for mounting screws in the back plate. All parts are easy of inspection, and renewal of vital parts is a very simple matter, owing to their accessibility and design.

Safety Switch With Glass Cover for Inspection.

A new safety switch in 2, 3 and 4-pole types is being placed on the market by the Super-Safety Electric Co., Chicago. The cabinet of this switch is made in two parts, one a box body consisting of both ends of the cabinet, the back and about one-fourth of each side. This portion of the cabinet is designed for the reception of the conduits and wires so as to be installed with the roughing in; the other portion consisting of a cradle, the switch, the door with a window, and the two sides of the box. Four screws act to hold the two portions of the entire device together.

The box is made of heavy metal with a heavy switch base and oversize contacts, all to insure long life and heavy duty. The device locks automatically so that the switch cannot be operated with the door of the cabinet open, but when the switch is in the full "On" position, the door can be opened and the fuses tested, without exposing live parts of the device.

In this device the fuses form a part of the actual switch, being rotated to a position back of an insulating shield when the switch is in the closed position. In the open position the fuses are turned in front of the shield and are separated from both the live or feeding terminals and from the equipment circuits. Thus, there are no exposed live parts with the switch either open or closed. The entire equipment is constructed in a substantial manner, and the manufacturer makes claim of numerous special advantages resulting from the various construction features.

The two accompanying illustrations give a good idea of how this device operates. The arrows, in each case, point to the small holes provided for fuse testing.

Studies on Work of Electric Trucks and Wheelbarrows.

One of the pressing business questions of the day is the elimination of industrial wastes. It is a factor that has an important bearing on the manufacturer's problem of meeting present economic conditions. Industrial waste may represent either material, labor or time. Material wastes are concrete, tangible, and for this reason have received closer study. On the other hand, labor wastes and time wastes, particularly unproductive labor and time represented in the handling of material, have not, generally speaking, received the attention their importance as a definite opportunity for effecting certain economy in manufacturing justifies.

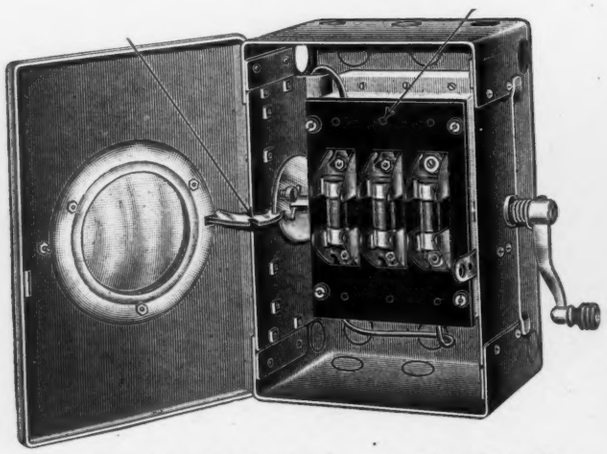
That there is that opportunity has been demonstrated time and time again in specific cases. That industry as a whole, and individual manufacturers in particular, may be materially benefited through approved mechanical handling methods is certain. Yet, it is stated, over 90% of the industrial plants in this country are still doing all or a large part of their lifting, transporting and conveying by hand labor. That this means a tremendous amount of money annually that could be made more productive is evident.

A series of elaborate time-motion studies on the work of electric storage battery trucks versus wheelbarrows recently made by the Yale & Towne Manufacturing Co. at its Stamford, Conn., plant is a case in point. Accurate records were first made on the cost of handling 600 tons of moulding sand from a freight car on the railroad siding to the moulding room in the foundry, 200 ft. away, 40 ft. of this distance being a 12% grade up a concrete ramp, with a sharp, right-angle turn into the shop at the top. It took 18 men with wheelbarrows and shovels 6 days, working 9 hrs. per day, to transfer the 600 tons of sand. The total cost was $545.72.

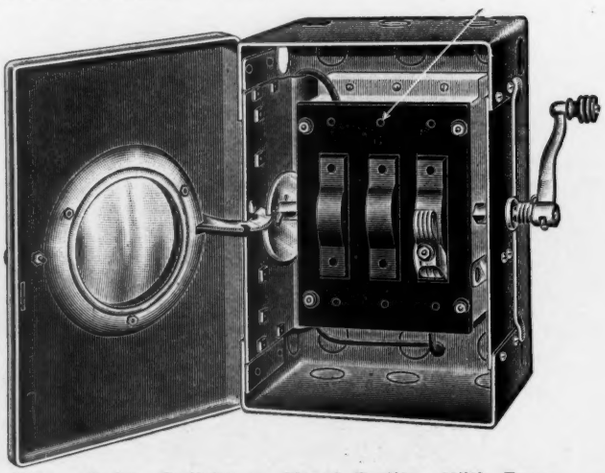
A few weeks later another 600 tons of the same sand, delivered by car to the same point, was transferred to the moulding room by means of a Yale electric truck equipped with a standard detachable end-dump body of 27 cu. ft. capacity. With one man driving the truck (one member of the former wheelbarrow gang) and an extra man with a shovel to help load the truck, this 600 tons of sand was transferred in 4 days, 9 hrs. work per day, at a total cost, including interest on capital invested, and charges for electric current used by the truck, of $183.60. Thus on this one job $362.12 was saved.

Yale Electric Industrial Truck Loaded with Sand, Running up a 12% Grade.

Combustion Engineering Corp., 43 Broad street, New York City, has issued in pamphlet form an address on "The Use of Powdered Fuel Under Steam Boilers" presented by H. D. Savage before the recent meeting of the American Iron and Steel Institute.



"Super Safety Switch" in Open Position With Fuses Exposed.

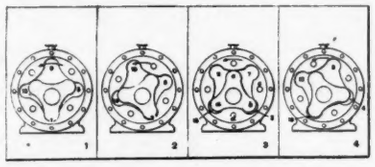


"Super Safety Switch" in Closed Position With Fuses Covered.

Exeter Rotary Pump Suitable for High Heads.

In speaking of the Exeter rotary pump, S. H. Farkas, vice-president of Exeter Machine Works, Inc., West Pittston, Pa., described them substantially as follows:

The types of rotary pumps now on the market may be classified roughly under two main basic principles: First, plunger or reciprocating pumps, and, second, centrifugal pumps. The turbine type can



Figs. 1 to 4—Diagrams Showing Various Positions of Pump Parts.

be also included in the second classification, although their relative action is not quite the same. Because of the inherent disadvantages heretofore found with most rotary types of pumps their use has not become very general in industry. Hydraulic engineers will generally concede that from a mechanical point of view plunger or centrifugal pumps leave much to be desired in general efficiency. An exceedingly close fit is necessary between the plungers and cylinders, and the resulting rubbing and wearing contact quickly brings about excessive slippage. Then, again, the inertia of the whole volume of the head of water must be overcome before maximum efficiency can be obtained.

This latter point is of the utmost importance, and it is due to the absence of this action that it has been possible to bring the centrifugal and turbine types up to their present state of high efficiency when running at relatively high speeds. Centrifugal and turbine types of pumps, however, are admittedly weak in creating suction and are not positive in action. They cannot profitably be used for conditions different than those for which the particular pump was originally designed. It follows therefore that if a rotary type of pump could be evolved which incorporated the positive action of the plunger pump with the continuous flow of the centrifugal or turbine types the ideal in mine pumping efficiency would be attained. It is towards this end that all engineers designing rotary pumps have striven, but the difficulties to be found in handling certain kinds of liquids have always been considered as hard to overcome. The necessity of keeping a tight joint and at the same time avoiding wear are most important factors to be considered. The rotary types thus far evolved may be divided broadly under these classifications: First, those using the rotary gear movement; second, the rotary plunger types, and third, the rotary bucket and packing strip types.

Practically all these various types require continuous replacements due to the great friction taking place between either the moving parts themselves or between the moving parts and the casing. It is no wonder therefore that the use of the rotary type of pump has heretofore been so restricted. The Exeter rotary pump is based upon an entirely new idea of rotary-pump construction. The pump creates its own suction, its action is positive, and the flow of the water is continuous. There are no valves and no reciprocating parts to get out of order, and compared with its output the size of the pump is extraordinarily small. Because of its rolling rather than rubbing surfaces the wear has been reduced to a minimum.

Broadly speaking, the underlying principle is a variant of the square-hole drilling device in which a triangular bit functions inside a restraining square former of equal size. This combination has been developed as a 3-tooth gear meshing with an internal 4-tooth gear set eccentrically one to the other. The irregular spaces increasing and diminishing in volume as the two rotate together are utilized to admit and eject the fluid. Using an equilateral triangle inside a square will of necessity give the greatest vacant space in relation to the size of the contacting pair. Any other combination—four to five, five to six, etc.—will more nearly approach equal size and consequently leave less void.

It is obvious that the pure geometrical forms would not function smoothly. The next step was to evolve by experiment such a series of curves on both members as would enable continuous contact to be maintained without shock, and rolling smoothly together. It is of more

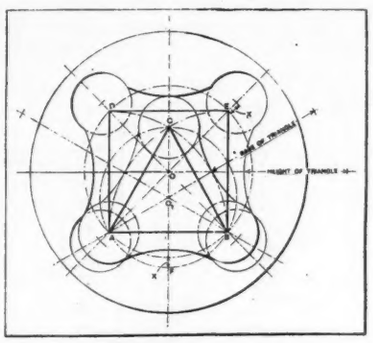


Fig. 5—Chart Showing Development of Pump Curves.

than passing interest to note that the solution found uses only circular arcs. The illustrations, Figs. 1 to 4, show the two rotating elements in sequence of position during one complete revolution. Fig. 5 shows the geometrical construction employed in the design of the two rotors.

Taking Fig. 5 first, an equilateral triangle *ABC* and a square of equal side are erected on a common base *AB*. The angles of the triangle are bisected and the lines produced; the diagonals of the square are also drawn and produced. The circumscribing circles of both triangle and square are also drawn. It will be seen that at the bottom of the figure a distance *X* is obtained by the intersection of the two circumscribing circles. With the points of the triangle as centers, circles with a radius equal to one-fourth of the common side of the triangle and square are described. With *O* as center and *OF* as a radius, the diagonals of the square are intersected. From the points so found as center, and with one-fourth the common side of the square and triangle as radius, circles are described. The joining arcs for the completion of the square figure are struck with the height of the initial triangle as radius, while the similar arcs on the triangular figure are struck with the side of the square or triangle as radius.

The first center found is along the vertical center line and the arc contacts with the extreme top of the triangular figure. The explanation is more involved than the actual construction, which can easily be followed from the diagram and the foregoing text using a pair of compasses. The only variation from the geometrical figures so found is that the recesses in the square figures are paralleled out so that the projections on the inner figure may enter. It will be readily seen that all the curves can be generated with relative ease, and even the variation mentioned presents no particular difficulty.

Taking the illustrations in Figs. 1 to 4 in sequence, in Fig. 1 the space "9" between the two rotors is at the maximum, the inlet port has just closed and the outlet port is about to open. The entire cycle of movement and variation of one space can be progressively followed through the four diagrams by the numbers 1 to 16. The capacity of the pump per revolution is equal to three times the volume of space 9.

The pump consists of an outer casing of cylindrical form having a pair of rotors meshing, the inner rotor being keyed to the driving shaft. These two rotors are set eccentric one to the other, the axial line being at the intersection of the bisection lines at *O* in the geometrical diagram, Fig. 5. The outer rotor has four ports which are open to the chamber of both the suction and discharge side of the pump during rotation. These

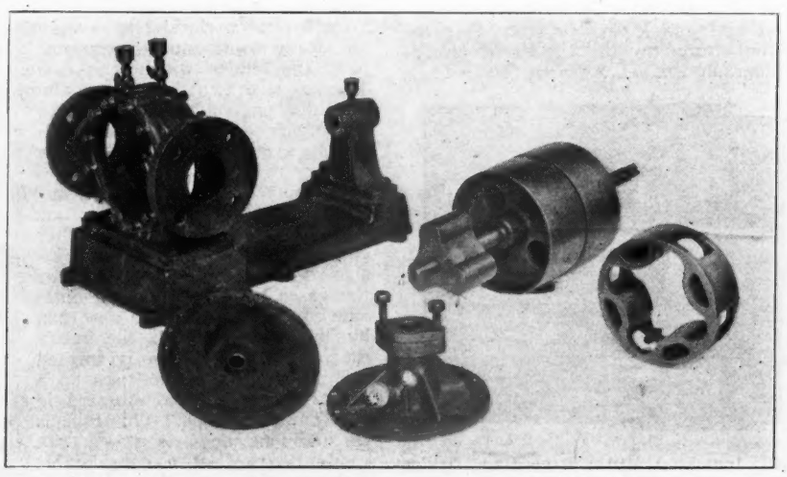


Fig. 6—Parts of Exeter Rotary Liquid Pump.

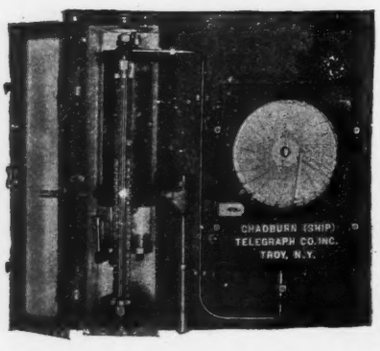
ports are closed momentarily by a lip at both the top and the bottom of the pump body in order to effect the cut-off between the suction and the discharge of the pump. Liquid is drawn into the pump through the ports of the outer rotor while the pocket is increasing, and forced out at the opposite side of the pump during the last half revolution when the pocket is decreasing. The rotors themselves are flat castings of suitable thickness, worked on edge to the figures described, their faces being in parallel planes. The outer rotating member is a working fit in the casting at its periphery and is otherwise free, the inner rotor imparting motion to the outer.

One of the chief defects common to every rotary pump has been that, due to local difference in speed, wear was irregular. Rotary pumps of very great initial exactitude for high duty and extreme conditions have been built, but such accuracy has heretofore been very difficult to maintain for any length of time, due to the variation mentioned. This trouble is common to each of the three general types of rotary pumps referred to, and there is no simple method of compensation for such irregular wear. Hydraulic engineers with the most extensive experience hold that reciprocation is preferable to rotation in a positive pump. In the Exeter rotary pump this objection is minimized to a very great extent, if not practically eliminated altogether. This is due to the maintenance of rolling action throughout.

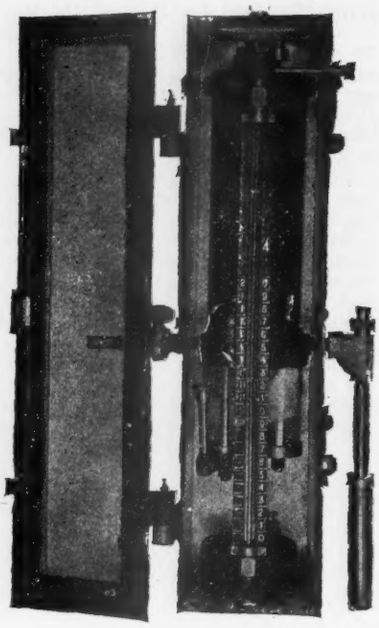
The pump is self-priming, easy of installation and can be adapted to a variety of pumping conditions. Dirt and grit do not seem to affect the pump, inasmuch as there is no rubbing or wearing contact. They are especially suitable for pumping water for irrigation, barometric condensers, suction roll work, evaporation pans, for boiler feed, circulating, lubricating or wet-vacuum work, and for handling oil, molasses, mine water, tar, chemicals, paints, turpentine, gasoline, soaps, etc. Smaller pumps thus far tested have shown a sustained volumetric efficiency of 98.67% and a pumping efficiency of between 70 and 82%. Tests will shortly be made with all-bronze pumps built for capacities ranging from 1200 to 2500 g.p.m. on heads of 100 to 700 ft. and the results achieved will be made the subject of a later article.

CO_2 Indicator of Simple Design and Rugged Construction.

A CO_2 indicator of rugged construction and simple in operation is being manufactured by the Chadburn (Ship) Telegraph Co. of America, Inc., Troy, N. Y. This instrument is intended for use in the boiler room and is in the form of a water-level gage calibrated in percentages of CO_2. It is calibrated so that it may be read from a considerable distance.



CO_2 Indicator With Recording Device Attached.



Chadburn CO_2 Indicator.

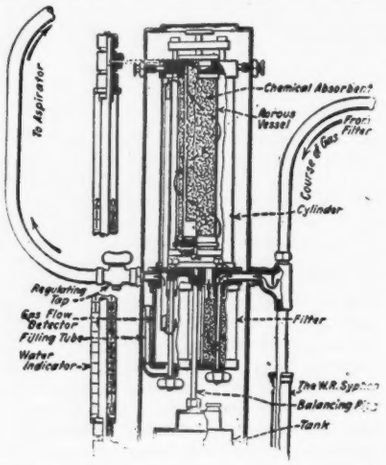


Diagram Showing Operation of CO_2 Indicator.

An aspirator worked by a minute jet of steam continuously aspirates gases from the flue to which it is connected. The gas is drawn through an aluminum filter and passed from thence into a chamber of the indicator containing a porous pot inside which is a dry reagent. A pipe connects the chamber with a vessel containing water into which dips one end of a second pipe, the other end of which is taken into the inside of the porous pot. Some of the gases penetrate into the interior of this pot and are absorbed by the reagent, with the result that a partial vacuum is formed and the colored liquid rises up a glass tube which is calibrated in percentages of CO_2. This tube is 18 ins. long and, as stated, can easily be read at a considerable distance. In cases where force or induced draft is in use the steam injector can be dispensed with although the amount of steam taken by the injector is very small—not more than 1 lb. per hr., according to the statement made by the manufacturer.

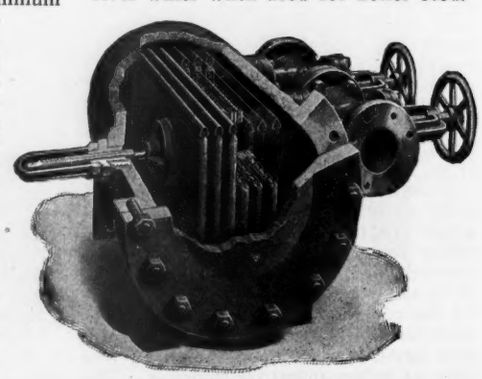
It is said by the manufacturer that this instrument is so constructed that it can be cleaned out when required by playing a hose upon it. Renewal cartridges inserted once in 24 hrs. maintain the instrument in continuous operating condition. The entire device is contained in a cast aluminum box 22.5 ins. high by 6 ins. wide and 5.5 ins. deep, the face being covered by a glass door for inspection.

Multiscreen Filter for Removing Oil from Water.

The Griscom-Russell Co., 90 West street, New York City, has recently placed on the market the G-R multiscreen filter, which is a redesign of the Reilly multiscreen feed water filter and grease extractor. The manufacturer states that the shell of the G-R multiscreen filter is of cast iron. The area of the filtering surface is 250 times the area of the water inlet passage, thus insuring a slow and efficient rate of filtration through the filtering cloths.

The filtering elements are interchangeable cartridges or envelopes of heavy terry cloth mounted on individual wire mesh rectangular frames. These cartridges are designed to present a maximum filtering surface in a given space. Reinforcing rings at the center of each cartridge act as spacers to keep the cartridges the proper distance apart. The cartridges, when in position, are forced one against the other by means of a compression screw, and the reinforcing rings then form a pipe for the passage of the water on its way out of the filter. By-pass valves, allowing the uninterrupted flow of water to the boiler, and a removable cover in the end of each filter for the removal of the cartridges, make cleaning an easy operation, requiring only a short time.

Condensed steam from engine cylinders, heating systems, etc., is stated to be an ideal distilled water for boiler feed and many manufacturing purposes, provided it is freed from oil, grease and other foreign matter in suspension. If this oil or material in suspension is allowed to enter the boiler it forms a coating on the heating surfaces, necessitating the burning of additional coal and often resulting in severe damage. It is claimed that the G-R multiscreen filter efficiently removes this oil, etc., from the water. It is also suitable for the removal of mud or sand from lake or river water when used for boiler feed.



G-R Multiscreen Filter.

ACTIVITIES IN THE TRADE

Business Developments, Sales Agencies, Trade Literature and Miscellaneous Items Concerning Electrical Manufacturers and Allied Business Interests

Terminal Electrical Supply Co. has leased ground floor space at 9-11 New street, New York City, for a local establishment.

Thomas A. Edison, Inc., West Orange, N. J., is planning extensions and improvements in the power house at its local electrical products manufacturing plant.

McPhilbin Lighting Fixture Co., 264 Fulton street, Brooklyn, N. Y., with plant at Queens, L. I., has filed notice of increase in its capital stock from $45,000 to $95,000.

City Battery Shop, Ltd., Toronto, Can., which was recently organized with a capital of $50,000, plans to manufacture electrical apparatus, storage batteries, etc. The incorporators are Lehigh H. Snider, H. B. Bell and Wilfred Field.

Majestic Electric Development Co., 656 Howard street, San Francisco, manufacturer of "Majestic" electric heaters, dental and surgical appliances, has issued a revised price list on its line of heaters showing reductions in the various types.

Combustion Engineering Corp., 11 Broadway, New York City, has been awarded a contract by the Bureau of Water, Philadelphia, for traveling grate stokers to be installed at the Shawmut and Queen Lake pumping stations at a cost of $41,534.

Peerless Light Co., 663 West Washington boulevard, Chicago, has issued a 4-page folder which contains a map of Chicago and surrounding territory and gives some pointers as to the quickest and best route to take to reach the Pageant of Progress.

Rite Electric Lamp Co., New York City, recently incorporated with a capital of $20,000, plans to manufacture incandescent electric lamps. Those interested include S. J. Berkawitz, 898 Broadway, Brooklyn, N, Y.; I. Rendelman and M. Sonin.

Multiple Storage Battery Co., Van Wyck avenue, Jamaica, L. I., N. Y., is planning the immediate erection of a 1-story plant addition, 60 by 120 ft., estimated to cost $55,000. John Lowry, Jr., 171 Madison avenue, New York City, is the building contractor.

Ventilating & Blow Pipe Co., Ltd., Montreal, Que., plans to manufacture sheet metal products, ventilating plants and equipment, blow pipes, etc. The company was recently incorporated with a capital of $50,000 by John W. Blair, Charles A. Hale, Francis J. Laverty and others.

Cutler-Hammer Manufacturing Co., Milwaukee, is distributing a booklet relating to Cutler-Hammer magnetic clutches. A cement company recently installed six 500 hp. and one 300 hp. synchronous motors for driving compeb mills. In order to overcome the inherently low starting torque of this type of motor, each installation included a magnetic clutch. The motor is allowed to attain full speed before the magnetic clutch is energized. The short interval which is required for the magnet to attain its full strength allows sufficient slip between the clutch surfaces to provide smooth starting of these mills. The booklet contains illustrations of the installations together with a number of other very interesting cuts, showing the use of synchronous motors and magnetic clutches.

A. H. Power Furnace Co., Ltd., Toronto, Can., which was recently incorporated with a capital of $40,000, plans to manufacture electrical fixtures, stoves, furnaces and gas ranges. The provisional directors are Stanley S. Mills, Vincent W. Price and Edward G. Goodwin.

Steel City Electric Co., 1207 Columbus avenue, Pittsburgh, manufacturer of electrical specialties, has announced the appointment of Kearton & Nagle, 71 West 23d street, New York City, as district sales representatives for the metropolitan district, New York City, and Newark, N. J.

Westinghouse Electric & Manufacturing Co., 165 Broadway, New York City, has secured a contract from the government of Chile for furnishing and installing electrical equipment for the electrification of the Chilian railway from Santiago to Valparaiso. The order is said to total $3,000,000.

Spencer Thermostat Co., Boston, which was recently incorporated, has elected the following officers: President and assistant treasurer, F. Wilder Pollard, 14 Commonwealth avenue, Boston; vice-president and treasurer, Laurence K. Marshall, 44 Rogers avenue, West Somerville, Mass.

Macbeth-Evans Glass Co., C. of C. building, Pittsburgh, has recently issued a folder entitled "Macbeth-Monax for Modern School Lighting," containing photographic views of two excellent installations and a brief description of the features and advantages of Macbeth-Monax glass.

Utility Battery Co. of America, Mount Prospect, Ill., which was recently incorporated with a capital of $5,000,000 under Delaware laws, will manufacture electric storage batteries and kindred equipment. Among those interested are H. L. Wuerffel, T. C. Fredericks and M. Luce, Mount Prospect, Ill.

F. W. Wakefield Brass Co., Vermilion, O., has recently issued a leaflet which explains the "Red Spot" line of spotlights manufactured by it. The feature of the most recent model is the Wakefield "silver lining" or inner shell, silvered and highly polished, which, it is stated, cannot tarnish from seepage, nor easily dent in service.

Stewart-Galvin Co., Marshfield, Wis., which was recently organized with a capital of $50,000, plans to manufacture storage batteries. It represents a merger of interests of the Stewart-Galvin Battery Co. and the Stewart Storage Battery Co. Among those interested are R. R. Williams, A. C. Felker and Amos Roll.

Triangle Conduit Co., Inc., 50 Columbia Heights, Brooklyn, N. Y., has announced the appointment of Thomas H. Bibber as general manager of the company's western business with headquarters at 1965 West Pershing road, Chicago. Mr. Bibber will continue to handle the production and sale of "Tri-cord," in addition to his new duties.

La Belle Manufacturing Co., Indianapolis, Ind., recently organized with a capital of $250,000 for the manufacture of electrically operated washing machines, is perfecting plans for the establishment of its proposed local plant to aggregate about 75,000 sq. ft. It is planned to develop an initial capacity of about 20,000 machines per annum.

Standard Underground Cable Co., Westinghouse building, Pittsburgh, has preliminary plans under way for the erection of a new manufacturing plant on 16th street. The company is also preparing tentative plans for its proposed new plant on property recently acquired at Kingshighway and Slevin avenue, St. Louis, with cost estimated in excess of $1,000,000.

Utility Compressor Co., Detroit, manufacturer of the "Utility" electric refrigerator, compressor and vacuum pumps, is building a factory at Adrian, Mich., which it is expected will be ready for occupancy about Sept. 1. The company states that as it will have considerably more space in the new plant it anticipates increasing production within a reasonable length of time.

Radio Corp. of America, Woolworth building, New York City, has completed the installation of six of the 12 new steel towers to form its new local radio plant at Port Jefferson, L. I., and it is expected to have the station ready for service early in the fall. It will be used for communication to France, Italy, Poland, Germany and other European points, as well as Argentina and Hawaii.

Pharo Manufacturing Co., manufacturer of the Pharo governor, has moved its business from Detroit to Bethlehem, Pa., where increased manufacturing facilities have been provided. The following officers were elected at a recent meeting: President, R. P. Hutchison; vice-presidents, G. C. Pharo and R. D. Chapman; secretary, I. W. Gangawer; treasurer, W. B. Myers, and purchasing agent, B. C. Sawyer.

PERSONAL MENTION

Biographical Sketches and Chronicle of Changes in Business Connections, Promotions and Other Personal News of the Industry

CHARLES E. HILDRETH, general manager of the Morgan Grinder Co., Worcester, Mass., recently acquired by the Greenfield (Mass.) Tap & Die Corp., has resigned.

JOHN D. RYAN has been elected a member of the Board of Directors of the Brooklyn Edison Co. to fill the vacancy caused by the resignation of Franklin W. Slater.

THEOPHILUS JOHNSON, JR., who was formerly connected with the General Electric Co., has been appointed general manager of the Wireless Specialty Apparatus Co., Boston.

JOHN D. NICKLIS has been appointed manager of supplies and purchases of Manning, Maxwell & Moore, Inc., and affiliated companies, with headquarters at 119 West 40th street, New York City.

B. M. W. HANSON, formerly vice-president and general manager of the Colt's Patent Fire Arms Manufacturing Co., Hartford, Conn., has been elected president of the Hanson-Whitney Machine Co. of the same city.

R. H. BARBER, who was recently appointed general sales manager of Roth Brothers & Co., 1400 West Adams street, Chicago, manufacturers of "Rothmotors," has a wide acquaintance in the west and middle western territories. During the past 12 yrs. Mr. Barber has represented the Century Electric Co., Northwestern Electric Co., Pittsburgh Transformer Co., Cutler-Hammer Manufacturing Co, and other manufacturers of electrical apparatus. He is an engineer graduate and before going into selling work, he spent several years gaining actual experience in the installation, operating and manufacturing field. Mr. Barber has for years taken an active part in the isolated plant industry and will be remembered by many for the work he did for the industry at Washington while a member of their executive committee.

R. H. Barber.

EVERETT MORSS, president of the Simplex Wire & Cable Co., Boston, has been elected president of the Boston Chamber of Commerce. He is chairman of the Executive Committee and a member of the corporation of the Massachusetts Institute of Technology.

ROBERT D. BLACK, formerly assistant sales manager of the Black & Decker Manufacturing Co., machinery manufacturer, Baltimore, has been appointed manager of the company's Philadelphia office to succeed W. C. Allen, who has been made a special factory representative, with headquarters at the Cleveland office of the company, 6225 Carnegie avenue.

JOHN J. SWAN has resigned his position with the Prest-o-Lite Co., Indianapolis, to become associated with the Engineering Business Exchange, 30 Church street, New York City. He graduated from Cornell University in 1897 and later held executive positions with the Ingersoll-Rand Co., Longmead Iron Co., Chicago Pneumatic Tool Co., Keller Manufacturing Co., and the American Arms Corp.

E. C. RICHARDSON, who has been manager of the Western Electric Compania Italiana at Rome and Milan since 1910, and who also saw foreign trade service at Antwerp, has been transferred to Peking, China, as general manager of the China Electric Co., the Far Eastern subsidiary of the International Western Electric Co. He succeeds C. H. Minor who has supervised the operations of the China Electric Co. ever since it started business early in 1918. Mr. Minor is returning to the European organization of the International company and will make his headquarters at London. Mr. Richardson was directing the activities of the Western Electric Compania Italiana last year when its works at Milan were taken over by the communists. He succeeded in protecting his American interests; and by his tact and knowledge of Italian labor conditions was able to resume operations long before most of the other foreign-controlled industries in Italy's great labor center. The new China Electric Co.'s manager will guide its sales policy in the great Celestial Republic.

D. W. NIVEN, an employe of the General Electric Co. for 21 years, and identified with the marine department since 1910, has been named manager of marine sales of the company by Vice-president J. R. Lovejoy. In his new position, Mr. Niven will direct sales to the Federal Government for naval and other purposes. Mr. Niven is a native of Scotland and served his engineering apprenticeship in Glasgow. He later became an employe of the Siemens Brothers of London and in 1900 came to this country and entered the employ of the General Electric Co. as a test man in the switchboard drafting department. From this department he went to the power and mining engineering and later entered the commercial section of the same department. In 1910, about the time the electric drive was first being developed for vessels, he was transferred to the marine sales department, where his advancemnt has been rapid and resulted in his new appointment.

D. W. Niven.

JULIUS KLEIN, who was appointed by the President as director of the Bureau of Foreign and Domestic Commerce to fill the position made vacant some time ago by the resignation of R. S. MacElwee, has assumed his duties. Dr. Klein first came to the Bureau in September, 1917, as chief of the Latin-American Division. He remained in that capacity until May, 1919, when he was made commercial attaché of the Department at Buenos Aires, Argentina. He resigned from that position in October, 1920. Born in San Jose, Cal., he received his education at the University of California, and later at Harvard, the Sorbonne (Paris), and the University of Berlin. The following degrees have been awarded him: B. Lit., M. Lit., A. M., Ph. D. (Harvard, 1915). Dr. Klein has traveled extensively in Latin America and Europe, investigating economic problems. He has specialized in Latin-American economics, trade, and politics, and since his resignation as commercial attaché he has held the chair of assistant professor of Latin-American history and economics at Harvard University. He comes from this position to the Bureau.

BUSINESS OPPORTUNITIES

News of Electrical Construction Projects in All Parts of the Country, Proposals Invited, Foreign Trade Openings and New Companies

EASTERN STATES.

Augusta, Me.—The Central Maine Power Co. has arranged for a bond issue of $3,000,000, the proceeds to be used for extensions, improvements, general operations, etc. Harvey D. Eaton is president.

Augusta, Me.—The Public Utilities Commission has granted permission to the Central Maine Power Co. to acquire the following properties, including power plants, franchises, etc.: Knox County Electric Co.; Readfield Light & Power Co.; Winthrop & Wayne Light & Power Co.; the Yarmouth Electric Co.; and the Maine Power Corp. The different properties will be merged and operated by the new owner under unified control.

Boston, Mass.—The John West Thread Co., 383 East Eighth street, is planning the rebuilding of the portion of its power house recently damaged by fire, with loss estimated at $12,000.

Great Barrington, Mass.—The Southern Berkshire Power & Electric Co. is considering the erection of a dam over the Housatonic river, to be used for hydroelectric generating service. The preliminary work is estimated to cost $150,000.

New Bedford, Mass.—The New Bedford Gas & Edison Light Co. has arranged for a bond issue of $572,000, the proceeds to be used for extensions, betterments, general operations, etc.

Bridgeport, Conn.—Electrical equipment will be installed in the proposed 1-story addition to be erected at the plant of the American Tube & Stamping Co., 471 Hancock avenue.

Hartford, Conn.—The Plimpton Manufacturing Co. will make extensions and improvements in the power house at its plant.

Amsterdam, N. Y.—The Fownes Brothers Co., 108 South Main street, will build a 1-story addition to the power house at its plant, to cost about $15,000.

Buffalo, N. Y.—City Commissioner Graves will secure estimates of cost and detailed information relative to the establishment of the proposed new municipal hydroelectric generating plant.

Glencove, L. I., N. Y.—The Glen Cove Light & Power Co. has filed notice of dissolution under state laws.

New York, N. Y.—The United Electric Light & Power Co. has filed plans for the erection of a 1-story works building on 132d street, near Walnut avenue, 60 by 175 ft.

Old Forge, N. Y.—The Village Council is arranging preliminary plans for the construction of a municipal electric power plant. Walter D. Marks is president of the council.

Syracuse, N. Y.—The Iroquois Utilities, Inc., City Bank building, is perfecting plans for the erection of an addition to its electric power plant at Concord, Erie county. Application for permission for the extension has been made to the Public Service Commission.

Hammonton, N. J.—Electrical equipment will be installed in the 2-story high school to be erected by the Board of Education, with cost estimated at $200,000.

Jersey City, N. J.—Electrical and mechanical equipment will be installed in the laundry to be erected at 220-26 Tonnele avenue by the Brunswick Laundry, Tonnele avenue, estimated to cost $41,000.

Linden, N. J.—The power plant at the asphalt works of the Warner-Quinlan Asphalt Co. was destroyed by fire recently.

Moorestown, N. J.—The Borough Council has taken bids for the installation of new electrical and other equipment at the local pumping plant for the waterworks system.

Verona, N. J.—The Borough Council has completed arrangements with the Essex Falls Water Co. for the installation of new electrical pumping machinery at the local waterworks.

Dover, Del.—The City Council has awarded a contract to W. M. Newton for the erection of its proposed 1-story power house. W. E. S. Dyer, Land Title building, Philadelphia, is engineer.

Farmhurst, Del.—The Delaware State Hospital has completed plans for the construction of a power house at the institution.

Biglerville, Pa.—The Biglerville Electric Light & Power Co. has been incorporated with a nominal capital of $5000, to operate a local light and power system. S. Z. Musselman, Orrtanna, Pa., is treasurer.

Carlisle, Pa.—The local chamber of commerce will secure estimates of cost for the installation of a street lighting system in different parts of the city. The project was considered a number of months ago, but has been held in abeyance due to high cost of materials.

Hauto, Pa.—The Pennsylvania Power & Light Co. is arranging for the erection of a large machine shop and repair works at its local generating plant.

Philadelphia, Pa.—The Board of Health has awarded a contract to Walker & Kepler, 531 Chestnut street, for the installation of equipment for the completion of the power plant now in course of construction at the Philadelphia General Hospital, at a cost of $12,602. The company has also secured a contract for the installation of new electric fixtures at the Nurses' Home at the hospital.

Pittsburgh, Pa.—The Valenci Borough Electric Corp. has been incorporated with a nominal capital of $5000, to operate a light and power system in Valenci Borough near Pittsburgh. R. M. Gilick, 1431 Fifth avenue, Pittsburgh, is treasurer. The same incorporators have also organized the Adams Township Electric Corp. and the Mars Borough Electric Corp., each with capital of $5000, to operate local electric systems.

Reading, Pa.—The Pennsylvania Edison Co. has disposed of a bond issue of $125,000, the proceeds to be used for extensions, betterments, general operations, etc. The company formerly was known as the Pennsylvania Utilities Co.

Topton, Pa.—The Kempton Electric Co. has been incorporated with a capital of $5000, to operate a local light and power system. D. S. Martin, Reading, Pa., is treasurer.

Wilkes-Barre, Pa.—The Wilkes-Barre Co. is planning to change over present direct current portions of its system to alternating current operation on Jan. 1. Consumers on South Main street and other districts affected have been notified, it is said, that new equipment will have to be provided.

Baltimore, Md.—The Public Service Commission has approved an agreement between the Consolidated Gas, Electric Light & Power Co. and the Chesapeake & Potomac Telephone Co., relative to combination lines.

Norfolk, Va.—The U. S. Shipping Board, Washington, D. C., is arranging for the construction of an electric power plant on Craney Island, Norfolk. Electric pumping machinery will also be installed.

South Boston, Va.—The Halifax Power Co., recently incorporated with a capital of $1,000,000, will operate a local light and power system. The company has perfected its organization with Ira Vaughn as president, and James F. Penrose, secretary, both of Philadelphia.

South Richmond, Va.—The U. S. Shipping Board is arranging for the sale of its local power house and boiler plant, built during the war period. The property comprises about 52 acres of land with frontage on the James river.

Staunton, Va.—The Weyers Cave Light & Power Co. is arranging for an increase in its capital stock from $100,000 to $200,000, for proposed expansion. W. E. Pence is president, and L. E. Long, secretary and treasurer.

Buchannon, W. Va.—The Buchannon Light & Water Co. has complet-

ed plans for the erection of its proposed power plant and will break ground for the structure at once.

Charleston, W. Va.—The Black Diamond Power Co. has been incorporated with a capital of $50,000 to install and operate a local electric light and power system. The company is headed by M. W. Gilliam and F. B. Lamb.

Atlanta, Ga.—One of the substations of the Georgia Railway & Power Co. at 146 Edgewood avenue was damaged by fire recently, the esimated loss being $10,000.

Savanah, Ga.—The Savannah Electric Co. has been authorized to spend about $40,000 for extending its lines to the Tri-State exposition grounds, 3.5 mi.

Savannah, Ga.—The Savannah Electric Light & Power Co. has been organized with a capital of $4,800,000 to succeed the Savannah Electric Co. Expansion plans are being arranged.

Arcadia, Fla.—The Southern Utilities Co. has commenced the construction of a high-tension line to Nocatee, Fla., for light and power service at this point.

Moore Haven, Fla.—The City Council has disposed of a bond issue for $20,000, the proceeds to be used for the construction of a new municipal electric lighting plant.

Webster, Fla.—The city has sold bonds for the purpose of erecting an electric light plant. Address the mayor.

NORTH CENTRAL STATES.

Bay Village, O.—The Northern Ohio Light & Power Co., Eagle Cliff, O., has plans nearing completion for the erection of an electric generating plant in the vicinity of Bay Village, estimated to cost $850,000. A. W. Harris, 913 Schofield building, Cleveland, is architect and engineer.

Columbus, O.—The Board of Trustees of the Ohio State University has plans in preparation for the construction of a power house at the college. It is expected to ask bids this month. Carl E. Steeb is secretary.

Doylestown, O.—The Doylestown Electric Light & Power Co. has been incorporated with a capital of $20,000. Among those interested are I. H. Stetler, E. H. McKinney, H. G. Petit, George Landis, N. R. Zimmerman and John Rise.

Randolph, O.—The Randolph, Suffield & St. Joseph Electric Light & Power Co. has been incorporated with a capital of $30,000, the incorporators being W. Biles and C. J. Lang.

Toledo, O.—Plans to establish an independent lighting system for all county buildings, including the courthouse, county jail and the juvenile home, are being forwarded by County Commissioner Dean.

Vanlue, O.—The Vanlue Electric Light Co. has been incorporated with a capital of $15,000, the incorporators being Guy F. Burnap, Harry J. Morehart, J. J. Herman, J. M. Bright and E. L. Plotts.

Escanaba, Mich.—Orders have been issued by the Board of Public Works for the extension of the power line from the municipal utilities plant to the new sewage pumping station at the foot of Ludington street.

Iron River, Mich.—The Bates Iron Mining Co. is planning the rebuilding of its power house and mechanical buildings recently destroyed by fire.

Bass Lake, Ind.—The Bass Lake Electric Light & Power Co. has been incorporated with a capital of $10,000 to operate a local system. The incorporators are E. C. Hewitt, C. H. Hoffman and J. W. Long.

Lafayette, Ind.—The Board of Directors of St. Elizabeth Hospital has completed plans for the construction of a power house at the institution. D. X. Murphy, Louisville Trust building, Louisville, Ky., is architect.

Linnton, Ind.—Estimates are being prepared by Shourds, Stoner & McCormick Co., 510 Tribune building, Terre Haute, Ind., architect and engineer, for the erection of a power and lighting plant. Address A. J. Miller, mayor.

Memphis, Ind.—The Memphis Electric Light & Power Co., recently organized, will operate a local light and power system. The company is headed by P. R. Carr, Otis Mayfield and L. C. Malott.

Mattoon, Ill.—An election may be held to vote on the question of issuing bonds to establish a municipal lighting plant in connection with the water system. Address C. I. Jarnes, superintendent of waterworks.

New Boston, Ill.—The Illinois Northern Utilities Co. will build a 33,000-volt transmission line through New Boston, and about 3 mi. of rural line also.

Milwaukee, Wis.—Plans are being prepared for a $2,000,000 electric power station to be erected by the Sewerage Commissioners. J. F. Fowler, secretary, City Hall. W. J. Sando, 1338 Wells building, consulting engineer.

Oshkosh, Wis.—The citizens are considering the installation of an ornamental lighting system. Address F. A. Fuller, member of the board of directors.

Remsen, Ia.—This city is to have a municipally-owned lighting plant. A contract was signed for two generating units, one of 100 hp. and the other of 200 hp. An effort is to be made to purchase the distribution system of the Iowa Light, Heat & Power Co., and if this cannot be done a new one will be built. Address the mayor.

Excelsior Springs, Mo.—The Excelsior Springs Light, Heat & Power Co. is planning the construction of a power line in the vicinity of Rayville, Mo. A franchise has been granted.

Joplin, Mo.—The Home Telephone Co. of Joplin will make improvements involving an expenditure of about $30,000. Address W. O. Randall, superintendent.

Lanagan, Mo.—The city council has under consideration the construction of a power line from the Lanagan power plant to Anderson. Address town clerk.

Marceline, Mo.—The contract for furnishing the "white way" lighting system in this city has been awarded to the Central States Electric Co. of Kansas City, Mo., and the contract for installing it to the J. E. Jordan Electric Co.

Sikeston, Mo.—The Missouri Public Utilities Co. will rebuild its power house recently destroyed by fire.

St. Louis, Mo.—A resumption of the placing of overhead wires underground in the residence section of the city, at the rate of 4 mi. a year is planned next year. This was decided at a meeting of the Board of Public Service recently, and recommended by Director Hooke of the Department of Public Utilities.

St. Louis, Mo.—The N. O. Nelson Manufacturing Co., 928 Chestnut street, manufacturer of plumbing fixtures, etc., will build power house at its works at Noblesville, Ind., in connection with extensions in the enameling furnace and other departments of the plant. L. D. Lownin is president.

Donalds, S. D.—The town will sell $12,000 bonds to construct and operate an electric light plant. Address B. H. Carleton, commissioner of public works.

Monroe, S. D.—Bonds to the amount of $9000 have been voted for the purpose of connecting up with a high-tension electric line to furnish light for the town. This city will connect up with the Bridgewater-Wall lake line as soon as it is built. It is understood that a contract with the Northern States Power Co. of Sioux Falls will be signed for the electrical energy.

SOUTH CENTRAL STATES.

Belzoni, Miss.—The Common Council has called a special election to approve a bond issue of $125,000, the proceeds to be used for extensions and improvements to the municipal electric power plant, and for other municipal work.

Meridian, Miss.—The City Council has awarded a contract to the Williams & Libby Engineering Co., Yazoo City, Miss., for the erection of a municipal electric light and power plant to cost about $600,000. Bonds for the improvement were recently approved.

Gibsland, La.—The Gibsland Electric Light & Power Co., recently organized, is planning the construction of a local power plant. A list of equipment has been arranged. E. W. Merritt is president.

Enid, Okla.—The Conner-Keltner Electric Co. has been incorporated with a capital of $75,000 to operate an electric power plant. The incorporators are C. L. Conner and Y. S. Keltner.

Hugo, Okla.—The Chamber of Commerce has surveys under way for the selection of sites for its proposed series of hydroelectric power plants, and has filed application with the

Federal Water Power Commission, Washington, D. C, for permission to utilize waters and construct the stations. The plants will be located on the Mountain Fork, Little and Kiamichi rivers, with proposed installations to total 150,000 hp., 100,000 hp., and 50 hp., at the respective locations noted. The Hugo Hydroelectric Power Co. is being organized to carry out the project.

Pawhuska, Okla.—The City Council has preliminary plans under way for the construction of a municipal electric light and power plant, in connection with other city improvements.

Sand Springs, Okla.—H. S. Shaner and associates are arranging for a bond issue of $4,000,000 to be used for the construction of the proposed new line of the Missouri Interurban railroad. A large hydroelectric generating plant for power service will be erected.

Weleetka, Okla.—At a recent special election citizens approved a bond issue of $82,500 for the construction of a municipal electric power plant.

Edinburg, Tex.—The City Commissioners have purchased a site for an electric light and water system. Address the mayor.

WESTERN STATES.

Phoenix, Ariz.—Bids will be received Aug. 11 for furnishing and delivering to the City Hall one hundred and twenty 6 by 12 "Alba" globes. Address V. A. Thompson.

Hoquiam, Wash.—The Commercial Club is now investigating the matter of installing a street lighting system.

LaGrande, Ore.—Walter Ross, Portland, Ore., was granted a franchise by the City Council for transmiting power through the town, and for individual and manufacturing use by erecting a power plant for distribution of light and power to farmers.

Yakima, Wash.—S. M. Henderson, manager of the Pacific Power & Light Co. at Toppenish has been authorized to proceed with the construction of the power line to McKinley school corner, about 3 mi.

Portland, Ore.—The Portland Railway, Light & Power Co. has filed with the state engineer an application to construct a reservoir to cost $2,000,000 on the Clackamas river. The proposed dam will be 160 ft. high and 950 ft. long of solid concrete masonry. It is also planned to build a second reservoir for which a conduit 5 mi. long is to be constructed leading to a power house. The estimated cost of the work is $3,000,000, construction on which is to be started in a year.

Los Angeles, Cal.—The Los Angeles Railway Co. will spend about $500,000 in carrying out a power extension program, according to an announcement by George J. Kuhrts. This sum will be used to erect automatic stations, said to be the latest development in the street railway industry.

CANADA.

Daysland, Alta.—The town plans to spend $14,000 on an electric light plant and equipment. Address the mayor.

Timmins, Ont.—Bids are being received for a direct connected motor-driven blower and electrical fittings for a sewage disposal plant. Address H. E. Montgomery, town clerk.

St. Prime, Que.—Cie Electricite is erecting a power house at a cost of $40,000.

Montreal, Que.—The Shawinigan Water & Power Co. has perfected plans for a bond issue of $2,500,000, the proceeds to be used for extensions, improvements, general operations, etc. The company is now operating hydroelectric power plants with total generating capacity of 337,700 hp.

INCORPORATIONS

Muskogee, Okla.—American Washing Machine Co. Capital, $25,000. To manufacture electrically operated washing machines and parts. Incorporators: W. F. Bickford, E. V. Vernor and J. M. Sims.

Sault Ste. Marie, Ont.—Rapid Electric Co., Ltd. Capital, $40,000. To manufacture electrical machinery, tools, etc. Incorporators: George L. Wilson, Arthur P. Crawford and Charles T. Toombs.

Leamington, Ont.—Auto Signal Light Co., Ltd. Capital, $50,000. To manufacture automobile signal lights, accessories, etc. Incorporators: Robert D. Sloan, George A. Brown, and Robert Fairful.

Louisville, Ky.—M. and M. Electrical Co. Capital, $15,000. Incorpoators: John McG. Miller and Joseph M. Marret.

Springfield, Mass.—Nagel Battery & Electrical Co. Capital, $35,000. To manufacture electrical equipment. Incorporators: Clarence L. Nagel and E. S. Hahn, Cambridge, Mass.

New Haven, Conn—Economy Electrical Manufacturing Co. Capital, $25,000. To manufactur electrical equipment. Incorporators: A. I. Lapides, S. D. Pardoll, and S. Jacobson, 1 Lawrence street.

New York, N. Y.—Rogel Lighting Fixture Co. Capital, $6000. To manufacture electrical fixtures. Incorporators: C. G. Robin, L. Gelfand, and I. T. Flatto, 261 Broadway.

Buffalo, N. Y.—Ideal Electric Dumbwaiter Co. Capital $50,000. To manufacture electrically operated lifting devices. Incorporators: J. A. Wechter, G. A. Irvin and J. D. Hillery. The company is represented by Sullivan, Bagley and Wechter, Chamber of Commerce building.

Louisville, Ky.—Brachey-Laird Battery Service Co. Capital, $10,000. To deal in electric storage batteries. Incorporators: H. C. Brachey, James M. Laird and Sheridan Brachey.

Oneida, N. Y.—W. H. Hess Electric Co. Capital $15,000. To manufacture electrical machinery. Incorporators: W. H. Hess, M. M. Dunn and M. E. Haigh.

Brooklyn, N. Y.—Minerva Electric Co. Capital $5000. To manufacture electrical specialties. Incorporators: J. Gelber, S. Lozer and A. Gelber, 543 Van Siclen avenue.

Trenton, N. J.—Samuel Kline, Inc. Capital, $25,000. To manufacture and deal in electrical specialties. Incorporators: Samuel Kline and Laurence S. Harrison.

Hackensack, N. J.—A. Hasbrouck, Jr., Inc. Capital, $125,000. To operate an electrical contracting business. Incorporators: Homer W., M. E. and A. Hasbrouck, Jr.

Hampton, Va.—Engineering Service Corp. Capital, $15,000. To operate an electrical engineering business. Vernon D. Wheelon, president; John S. McFall, secretary.

Indianapolis, Ind.—Helsbels-Indiana Co. Capital, $20,000. To deal in electrical equipment. Incorporators: Harry A. and K. V. Olin, and Roy C. Cummins.

Tulsa, Okla.—Good Housekeeping Electric Co. Capital, $20,000. Incorporators: J. W. Callaway and F. E. Preach.

New York, N. Y.—Walsh & Mead, Inc. Capital, $10,000. To manufacture electric motors and parts. Incorporators: W. R. Walsh, R. Mead and W. Smith. The company is represented by Wechsler & Kohn, 128 William street.

New York, N. Y.—Atlantic States Electric Co., Inc. Capital, $50,000. To operate an electrical engineering and contracting business. Incorporators: Anderson J. Campbell and James C. Embry, New York; Lee J. Purnell, Brooklyn, N. Y.

Hackensack, N. J.—National Radio Electric Sign Co. Capital, $25,000. To manufacture electric signs. Incorporators: Cornelius A. Cole, Hackensack; Arthur R. Oakley, Pearl river, N. Y.; and A. Von Voorhis, Jersey City, N. J.

FOREIGN TRADE.

[Addresses of firms referred to in these trade opportunities may be obtained by writing to the Bureau of Foreign and Domestic Commerce, Washington, D. C., or its branch and local co-operative offices. Request for each opportunity should be on a separate sheet and the file number given.]

Electrical Goods (35,229)—A commission agent in India desires to be placed in touch with exporters of electrical goods. Reference.

Electric Motors (35,146)—An advertising sign company in England desires to purchase electric motors of fractional horse-power (1/20 to 1/50); universal; voltage 100 to 250; complete with suitable reduction gear to run a cam shaft 5 r. p. m.; the cam will operate an advertising sign, and the maximum weight to be lifted is about 4 lbs. It is also desired to secure spring motors to do the same work in places where electricity is not available. Quotations should be given c. i. f. English port. References.

Electrical Goods (35,375)—A mercantile firm in Ireland desires to secure an agency for the sale of electrical goods. Reference.

Vacuum Cleaners (35,272)—A merchant in Ireland desires to secure an agency for the sale of vacuum cleaners. Reference.

FINANCIAL NEWS

Comment on the Financial Outlook in the Electrical Industry, New Securities, Reports of Earnings, Dividends and Utility Stocks

Cleveland Electric Illuminating Co. Bonds Offered to Public.

An issue of $5,000,000 Cleveland Electric Illuminating Co. 20-yr. 7% sinking fund gold debenture bonds has been offered by Dillon, Read & Co., Chicago, at a price of 95 and interest to net about 7.5%. The Cleveland Electric Illuminating Co. operates in the city of Cleveland and adjacent industrial and surburban territory, serving with electric light and power an estimated total population of over 1,200,000. The net income of the company available for interest for the 12 mo. ended June 30, 1921, was equal to 3.60 times the interest charges accrued for the period, and averaged $3,079,263, or approximately four times the average annual interest charges for the five calendar years to Dec. 31 last.

Offering of Brooklyn Edison Co. Gold Bonds.

The Guaranty Co. of New York and the National City Co. of New York are offering at 98.5 and interest, to yield about 7.15%, an issue of $3,000,000 general mortgage series "D" 7% gold bonds of the Brooklyn Edison Co., Inc., dated Dec. 1, 1920, and due Dec. 1, 1940. The increasing demand for Brooklyn Edison service has necessitated the expenditure for additions, extensions and improvements from Oct. 1, 1912, to June 30, 1921, of over $27,500,000. Against this additional investment only $15,500,000 par value of mortgage bonds have heretofore been issued. The proceeds of this issue will be used further to reimburse the company for such capital expenditures.

Bond Offering of Detroit Edison Co.

The Detroit Edison Company has sold $5,569,000 of its first and refunding mortgage 6s, series B, due July 1, 1940, to a syndicate composed of Coffin & Burr, Inc., Spencer, Trask & Co., the Harris Trust and Savings Bank, the Security Trust Co. and the First National Co. of Detroit. This syndicate is offering the bonds at 88 and interest, to yield over 7.15%.

Subscriptions to New Stock of A. T. & T. Co.

The American Telephone & Telegraph Co. has announced that rights to subscribe to more than 93% of the $59,819,500 new stock have been exercised and subscriptions received therefor. The expected balance remaining will be applied toward meeting subscriptions already received from employes under the company's employes' stock plan. On May 10 the company offered $90,000,000 new stock at par in the ratio of one new share for every five held. Right to subscribe expired July 20. On March 30 the company's capital stock was increased by $500,000,000, bringing the authorized capital to $750,000,000, including the $90,000,000 new stock. There is $532,825,000 stock outstanding.

Allis-Chalmers Manufacturing Co. Makes Good Showing.

For the 6 mo. ended June 30 last the net earnings after taxes of the Allis-Chalmers Manufacturing Co., Milwaukee, approximated $1,500,000, equal after preferred dividend requirements to close to $4 a share on the $25,770,750 common stock. Current dividend on the junior shares is $4 annually. Gross business for the second quarter amounted to close to $8,000,000, against $7,656,000 for the first 3 mo., and $31,516,000 for the 1920 year. In other words, the company in the first half of this year was doing a gross business equal to an annual basis to that of both 1920 and 1919. Unfilled orders March 31 last amounted to $12,943,000. Incoming orders at the close of the first 6 mo. of this year were coming in at the rate of 40% of normal production. With orders on hand, Allis-Chalmers is able to keep its operations at a much greater percentage of normal.

Business with Allis-Chalmers was at its low point during the early months of this year. Since then there has been distinct improvement, which so far has been cumulative. From the viewpoint of incoming business, the current month is the best so far this year. A good part of the new business is coming from public utility corporations, which after many lean years are beginning to receive benefits from increased rates and are coming into the market for new equipment for additions to plants, such as generators and motors. Allis-Chalmers' large working capital remains intact. At the close of June, the company had net quick assets of more than $25,000,000.

The following table shows net earnings available for dividends by quarters since Jan. 1, 1920, with quarter ended June 30, 1921, estimated:

	1921.	1920.
First quarter	$774,189	$ 767,215
Second quarter (est.)	800,000	832,747
Third quarter	.....	925,325
Fourth quarter	.....	1,038,961

Fort Worth Power & Light Co.

	1921.	1920.
May gross	$ 207,046	$ 168,716
Net after taxes	99,982	88,415
Total income	100,297	89,054
Surplus after charges	83,568	72,583
12 mo. gross	2,908,588	1,696,506
Net after taxes	1,072,985	871,543
Total income	1,078,938	878,950
Surplus after charges	880,264	715,417
Balance after preferred dividends	776,594	619,321

Arkansas Valley Railway, Light & Power Co.

12 mo. ended May 31.	1921.	1920.
Gross earnings	$1,903,675	$1,687,554
Net earnings	598,796	572,789

Western States Gas & Electric Co.

12 mo. ended May 31.	1921.	1920.
Gross earnings	$2,376,608	$2,050,644
Net earnings	818,879	833,221

The Detroit Edison Co. and Subsidiaries.

	1921.	1920.
June gross	$1,728,216	$1,607,803
Net after taxes	406,453	204,270
Surplus after charges.	123,160	11,838
6 mo. gross	11,624,400	10,309,002
Net after taxes	3,065,798	2,142,894
Surplus after charges	1,420,019	1,065,950

Southern Utilities Co.

	1921.	1920.
June gross	$ 224,655	$ 222,412
Net after taxes	54,388	44,871
Total income	54,476	44,956
Surplus after charges	33,476	26,802
12 mo. gross	2,832,161	2,390,854
Net after taxes	571,459	454,974
Total income	574,057	456,689
Surplus after charges	337,649	249,676
Balance after preferred dividends	335,189	249,676

Pacific Power & Light Co.

	1921.	1920.
May gross	$ 238,556	$ 204,110
Net after taxes	97,088	88,290
Total income	103,542	89,590
Surplus after charges	48,793	44,843
12 mo. gross	2,827,201	2,367,238
Net after taxes	1,276,044	1,112,239
Total income	1,339,732	1,121,187
Surplus after charges	710,044	589,423
Balance after preferred dividends	487,794	398,129

Fort Smith Light & Traction Co.

12 mo. ended May 31.	1921.	1920.
Gross earnings	$1,072,571	$ 957,347
Net earnings	303,419	289,033

Dividends.

	Term.	Rate.	Payable.
Amer. Tel. & C.	Q	1.25%	Sept. 1
Am. Waterworks & El., pfd.	Q	1.75%	Aug. 15
Commonwealth Gas & El., prd.	Q	1.5%	July 15
Consolidated Gas.	Q	1.75%	Sept. 15
Pacific Gas & El., pfd	Q	1.5%	Aug. 15
Tampa Elec.	Q	$2.50	Aug. 15
J. G. White & Co., pfd.	Q	1.5%	Sept. 1

WEEKLY COMPARISON OF CLOSING-BID PRICES OF SECURITIES OF LEADING ELECTRICAL COMPANIES.

Quotations furnished by F. M. Zeiler & Co., Rookery Bldg., Chicago.

Public Utilities—	Div. rate. Per cent.	Bid July 26.	Bid Aug. 3.
Adirondack Electric Power of Glenns Falls, common	6	9	9½
Adirondack Electric Power of Glenns Falls, preferred	6	69	69
American Gas & Electric of New York, common	..	100	102
American Gas & Electric of New York, preferred	6	36	36½
American Light & Traction of New York, common	..	82	91
American Light & Traction of New York, preferred	6	77	77
American Power & Light of New York, common	4	53	53
American Power & Light of New York, preferred	6	62	62
American Public Utilities of Grand Rapids, common	..	6	5
American Public Utilities of Grand Rapids, preferred	7	17	17
American Telephone & Telegraph of New York	..	104	106
American Water Works & Elec. of New York, common	..	3½	3½
American Water Works & Elec. of New York, particip	7	8	8
American Water Works & Elec. of New York, 1st preferred	..	47½	47
Appalachian Power, common	..	4	4
Appalachian Power, preferred	7	27	28
Cities Service of New York, common	+extra	116	119
Cities Service of New York, preferred	6	43	45½
Commonwealth Edison of Chicago	8	109	109
Comm. Power, Railway & Light of Jackson, common	..	10	10
Comm. Power, Railway & Light of Jackson, preferred	6	30	30
Federal Light & Traction of New York, common	..	6	6
Federal Light & Traction of New York, preferred	..	42	42
Northern States Power of Chicago, common	..	38	36
Northern States Power of Chicago, preferred	ex.div.	7	78	79
Pacific Gas & Electric of San Francisco, common	..	53½	54
Public Service of Northern Illinois, Chicago, common	7	79	78
Public Service of Northern Illinois, Chicago, preferred	6	80	80
Standard Gas & Electric of Chicago, common	..	8½	8
Standard Gas & Electric of Chicago, preferred	8	31	31½
Tennessee Railway, Light & Power of Chattanooga, common	..	¾	¾
Tennessee Railway, Light & Power of Chattanooga, preferred	6	3½	3½
Western Power of San Francisco, common	..	23½	26
Western Union Telegraph of New York	..	85	86
Industrials—			
General Electric of Schenectady	8	124	118
Westinghouse Electric & Mfg. of Pittsburgh, common	7	44½	43½